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PC Labs Tests
66 New 120- and
133-MHz Desktops

ISDN Gets Respect

We Review Four
New Low-Cost
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MAGAZINE

PC Labs Tests the Real

WINDOWS



95

And Compares It with

OS/2

WIN 3.1

NT

■ Is It
Really
Easier?

■ How
Fast Does
It Run?

■ Is It
More
Stable?

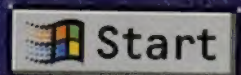
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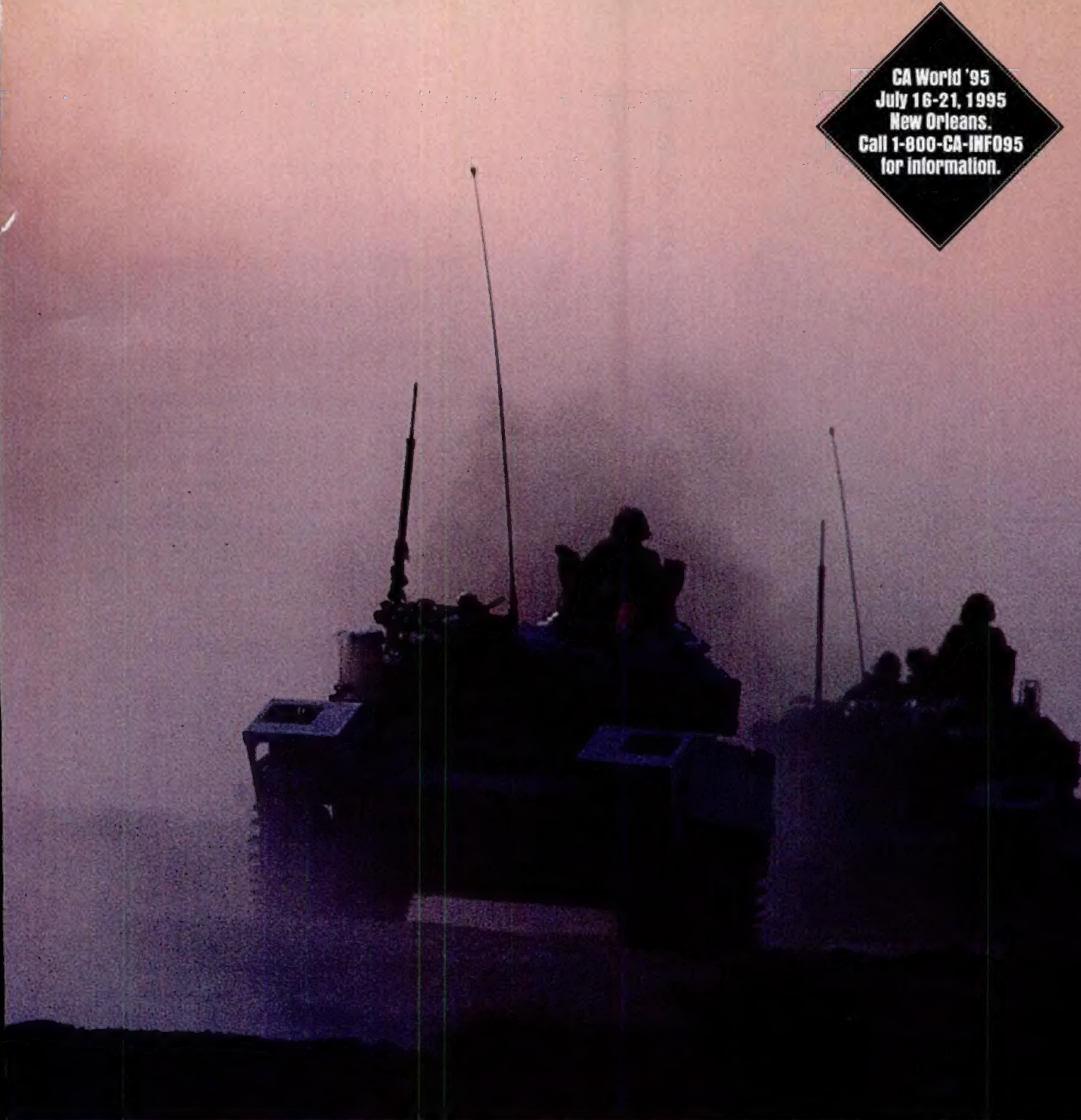


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Inside

How do you evaluate an operating system? That's the question we posed to PC Magazine Labs several months ago as we prepared for the release of Microsoft Windows 95 and OS/2 Warp Connect. Our PC Labs team, headed by software tech-

nical director Ben Gottesman, responded to the challenge by developing a series of complex tasks designed to look at performance, stability, and compatibility.

For ten weeks, a team of 17 analysts and technicians wrestled with the complexities of Windows 3.1, Windows for Work-

ating systems being tested, run our test scripts, solve as many compatibility problems as possible, run the scripts again, and so on. Then they had to wipe the hard disks, get the machines back to the original OS, and start the process all over again.

The summary: 6,000 hours'



Our review team mind-melded with Windows 95.

groups, OS/2 Warp Connect, Windows NT, and Windows 95.

Our testing had some interesting highlights. Project leader Jay Munro did some multitasking of his own—running multitasking tests on multiple operating systems on multiple machines at the same time. Technical analyst Laura Cox and her team had to set up rows of machines, each running Windows 3.1 or Windows for Workgroups, and then upgrade those machines to one of the oper-

labor devoted to testing for this one story; 5,000 performance tests run; nearly 1,000 compatibility tests run. And then the Labs team turned the package over to senior editor Thomas Mace and his team for additional writing, editing, and illustration. The result is our cover story, "Your Next Operating System."

Great jobs, guys! Now go home and rest up, so we can get started on the next issue.

—Michael J. Miller

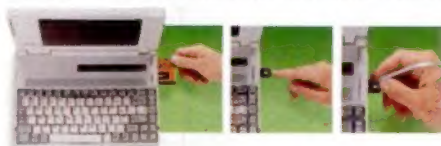
PC Magazine, ISSN 0888-8507, is published twice a month except in July and August, for \$49.97 for one year. Ziff-Davis Publishing Company, L.P., One Park Ave., New York, NY 10016-5802. Second-class postage paid at New York, NY 10016-5802 and at additional mailing offices. POSTMASTER: Address changes to PC Magazine, P.O. Box 54093, Boulder, CO 80322-4093. GST registration number: R-123669673; in Canada, R140496720. Canada Post International Publications Mail Product (Canadian Distribution) Sales Agreement No. 266477.

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UP FRONT

COVER STORY

Inside

The Windows 95 challenge.....4

Letters

Open your home to a
Pentium19

Trends

- The Web's financial district
- American-made LCD panels
- All-in-one Internet suites
- Virtual prototyping29

First Looks



- WinFax Scanner
- Xres
- Helix Hurricane
- Conversions Plus37

New & Improved

BY MELISSA J. PERENSON61

Read Only

EDITED BY TIN ALBANO69

COLUMNISTS

Michael J. Miller

Windows 95 Is Far from
Chicago.....75

Bill Machrone

Disabling Technology83
Second Looks85

John C. Dvorak

Grandma's Old Computer89
Inside Track91

Jim Seymour

ZIP Tricks: First, Find One for
Sale93

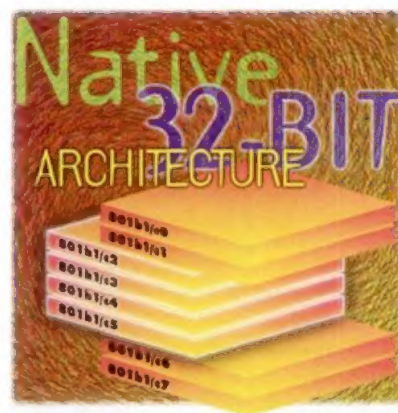
Bill Howard

Winners and Losers in '95.....95

Your Next OPERATING SYSTEM

BY MICHAEL J. MILLER

At long last, Microsoft has delivered Windows 95! But is it right for you or not? To help you decide, we put the shipping version of Windows 95 through hours of exhaustive testing, measuring its performance, stability, capacity, and compatibility against the dominant operating systems on today's PCs: Microsoft Windows 3.1, Microsoft Windows for Workgroups 3.11, IBM's OS/2 Warp Connect Version 3, and Microsoft Windows NT Workstation 3.51. We also compare their user interfaces, contrast their bundled applications, survey their networking features, and lift the covers of their underlying architectures. An operating-system upgrade is serious business. Here's what you need to know about 32-bit platforms to make the right choice102



The Big Picture	108
Architectural Review	132
Performance Results	144
Stability & Capacity	162
Compatibility Compared	172

PCs

SETTING THE PACE

BY ROBERT S. ANTHONY

PCs based on Intel's 120- and 133-MHz Pentium processors offer breathtaking performance at remarkably reasonable prices. With 150-MHz Pentiums due soon, the current kings of the hill may not reign supreme for long—but in the meantime, power users will find them irresistible. PC Labs tests 66 high-end Pentium PCs to see which ones are truly leading the pack.....183

Vendors of products reviewed:

<i>Acer America Corp.</i>192	<i>Gateway 2000 Inc.</i>214	<i>Quantex Microsystems Inc.</i> ...226
<i>All Computer Warehouse</i>195	<i>GST/Micro City</i>214	<i>Reason Technology Inc.</i>228
<i>American MultiSystems</i>195	<i>HD Systems Inc.</i>214	<i>Royal Computer Inc.</i>228
<i>AST Research Inc.</i>195	<i>Hewlett Rand Corp.</i>217	<i>SAG Electronics</i>228
<i>AT&T Global</i>	<i>HiQ Computer Systems</i>217	<i>Sys Technology Inc.</i>230
<i>Information Solutions</i>200	<i>Hymco Technologies Inc.</i>218	<i>Tagram System Corp.</i>230
<i>Compaq Computer Corp.</i>200	<i>IPC Technologies Inc.</i>219	<i>Tangent Computer Inc.</i>230
<i>CompuTrend Systems Inc.</i> ...201	<i>Maximus Computers</i>220	<i>Tatung Company</i>
<i>Comtrade</i>204	<i>Micron Electronics Inc.</i>221	<i>of America Inc.</i>232
<i>Dell Computer Corp.</i>205	<i>MidWest Micro</i>222	<i>Tri-Star Computer</i>232
<i>DFI</i>206	<i>Mitsuba Corp.</i>223	<i>Unitek Technology Inc.</i>232
<i>Digital Equipment Corp.</i>206	<i>Multiwave Technology</i>224	<i>USA Flex Inc.</i>234
<i>DirectWave Inc.</i>211	<i>National</i>	<i>Vektron International Inc.</i> ...234
<i>DTK Computer Inc.</i>212	<i>MicroComputers</i>225	<i>Zenith Data Systems</i>234
<i>Ergo Computing Inc.</i>212	<i>NETIS Technology Inc.</i>226	<i>Zenon Technology Inc.</i>236
<i>Everex Systems Inc.</i>212	<i>Percomp MicroSystems Inc.</i> ..226	<i>Price/Performance Index</i> ...190
	<i>Polywell Computers Inc.</i>226	<i>Performance Tests</i>196

PC Magazine At Home

50 REASONS TO GO
BACK TO SCHOOL

Whether your youngsters are preschool or premed, *PC Magazine* can help you choose the right products to help them earn straight A's. We look at 50 programs that can assist with everything from learning the alphabet to learning human anatomy. We also offer tips on choosing the right PC to run all these programs on and ways to get homework help on-line. There's also a chart to help you match subject and age range. So start studying!.....369

<i>Preschool</i>370	<i>Cut and Paste</i>
<i>Kindergarten-Grade 6</i>374	<i>Your Way to an A</i>379
<i>Grades 6-12</i>379	<i>Choosing the Best PC to</i>
<i>College and Beyond</i>389	<i>Take Back to School</i>384
<i>Dialing for</i>	<i>Five Utilities Every Parent</i>
<i>Homework</i>376	<i>Should Have</i>390



NETWORK EDITION

Follows page 96

Cover Story

ISDN Routers.....	NE1
• Pipeline 50.....	NE10
• Everywhere 2060-RO.....	NE12
• DirectRoute Remote RO-1.....	NE17
• NetBlazer LS ISDN.....	NE19

First Looks

Storage Manager 4.0.....	NE21
--------------------------	------

HSM for NetWare 2.0.....	NE22
Intel EtherExpress PRO/100 Smart.....	NE26
OpenServer Release 5.....	NE47
Motorola BitSurfr.....	NE48

New & Improved

WinFrame for Networks.....	NE59
CreditCard Ethernet+Modem 28.8.....	NE59
NetTools 5.3.....	NE59
MegaSwitch 100 Fast Ethernet switches.....	NE59

PCnet-Mobile.....	NE60
Norton Desktop Administrator 1.0.....	NE60
SafeStor/PT.....	NE60

The Networker

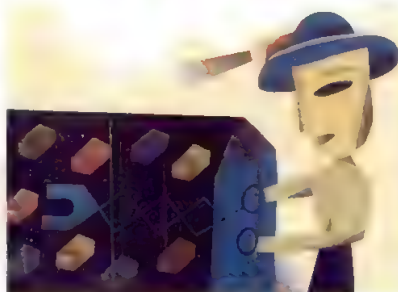
BY DIANE DANIELLE	
Tricks Up Your Sleeve.....	NE57

Multiple Access

BY O. RYAN TABIBIAN	
Switch Access to the Rescue.....	NE66

PC TECH

PC Databases As Query Tools



BY SAL RICCIARDI
Borland Paradox and Microsoft Access have learned more than a few tricks from dedicated client/server query tools.....239

Tutor

BY JEFF PROSISE
Quick: What's the best FILES setting for your PC?.....245

Inside Windows 95

BY MATT PIETREK
The programming of our OS crash tests.....251

Power Programming

BY RAY DUNCAN
Readers strike back about the World-Wide Web.....257

Internet Working

BY SEAN GONZÁLEZ
SATAN and Courtney:
A devil of a team.....265

Utilities

BY NEIL J. RUBENKING
InCtrl2 lets you practice safe setup.....269

PC SOLUTIONS

User-to-User

BY NEIL J. RUBENKING
A quick way to find out the number of files and the space they occupy in a particular directory; find out what file changes an install program makes.....285

Hardware

Getting two IDE hard disks to work in one PC; when you can't boot up from a 3.5-inch disk.....288

Operating Environments

Create your own screen savers; how to prevent Windows from occasionally starting automatically during boot-up; disappearing program groups in Windows.....295

Word Processing

Creating professional-looking equations in WordPerfect.....300

Spreadsheets

Splitting large files into subsets using a small QuickBasic program.....304

Databases

How to determine whether a specified directory exists from FoxPro for Windows.....304

Graphics

Object linking and embedding offers substantial benefits but may produce huge files.....308

AFTER HOURS

Abort, Retry, Fail?

BY DON WILLMOTT.....400

ALSO IN THIS ISSUE

PC Direct.....	288
Marketplace.....	339
Premier.....	339
Classified.....	354
BusinessCard.....	365
Reader Service Card.....	351
Advertisers' Index: Companies.....	395
Advertisers' Index: Products.....	396
Coming Up.....	398
Editorial Product Index.....	399



Unique software marketing strategies (page 400).

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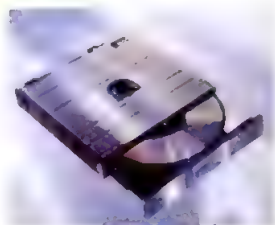
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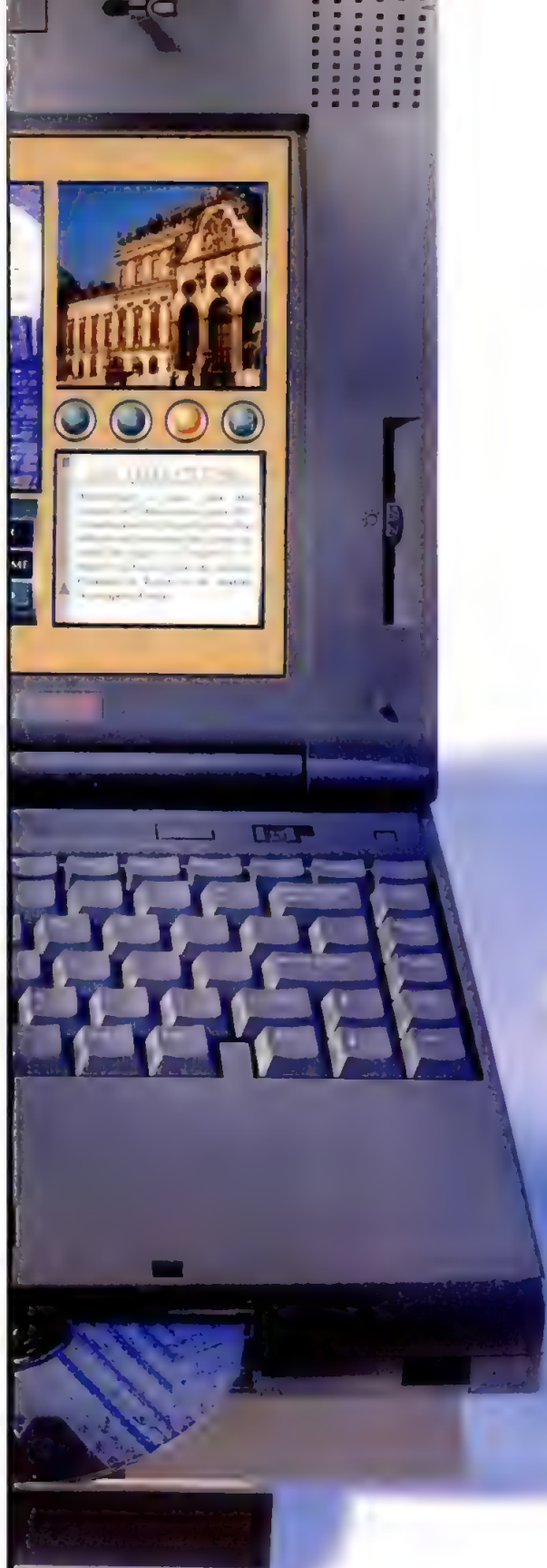


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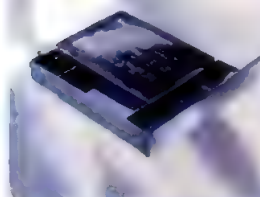


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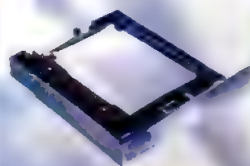
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CIRCLE 316 ON READER SERVICE CARD

Letters

A PENTIUM TO CALL MY OWN

The wonderful article on home Pentiums ("A Pentium for Every Home," May 16, 1995) was really enjoyable. It particularly made my day since I'd just ordered the Micron P90 you chose as Editors' Choice.

MADLINE L. BAUGHER, *via the Internet*

I'd like to commend you for conducting out-of-the-box software compatibility tests. I can't think of a better way to test hardware and software. These compatibility tests, coupled with the usual speed and performance tests, should become the standard for hardware and software reviews.

KEVIN SHOCKEY, *via the Internet*

Not all of your home users are totally naive and afraid of setting up a non-paint-by-numbers system. Nor do we all value ease of setup over major downtime. Please reserve the top rankings for those systems that offer the best overall values, not just color-coded cables.

RICHARD HALTER, *via the Internet*

Regarding your recommendation of Compaq and Packard Bell computers for the home, I can only wonder what planet you're from. Both companies manufacture PCs that are among the most expensive to repair.

JOHN DUNCAN, *via PC Magnet*

It was open-minded of you to mention that there is a Macintosh alternative to a Pentium home system ("The Macintosh Option: The Performa 6110," May 16, 1995). I found it disturbing, however, that you described features in the Mac operating system, now 11 years old, as "Windows 95-like."

TODD GRAHAM, *Sydney, Nova Scotia*

Most computer users already know who's the real graphical-user-interface copycat. Wouldn't it be more fair to say that Windows 95 is packed with System 7.5-like features?

HAIBIN B. JIU, *via the Internet*

BUGGY EXPECTATIONS

I agree wholeheartedly with Robin Raskin's observations regarding the lack of quality control in the computer industry today ("Bugs in Your Bonnets," May 16, 1995). The idea that reviewers can help the situation by being really hard on bugs is a good one. Perhaps a product's market readiness should be another criterion by which software is judged in your reviews.

ANNE SAINZ, *via PC Magnet*

People who complain about bugs tend to have experienced something that went desperately wrong. The Lion King CD-ROM is a great example. It would be bad enough even if the software had installed flawlessly, and Simba's



Not all home users fear a computer that lacks a paint-by-numbers setup.

roar sounded like a mouse on steroids. But The Lion King didn't even install properly. Today's buggy software doesn't just have a couple of minor problems; often the software doesn't run at all. We, as consumers, hold high expectations for these programs that we've paid good money for, and software publishers should know that consumers' diminished expectations come at a price.

KEVIN L. REED, *via PC Magnet*

The idea that consumers should be tolerant of inferior products goes against the philosophy of the American marketplace. Consumers have the right to demand quality, and peril the producer that ignores that right.

JESSE SOWELL, *via PC Magnet*

REMEMBER THE ERGONOMIC TOUCH

Bill Machrone's column "Taste vs. Technology" (May 16, 1995) addresses ergonomics, but some of his assumptions lack perspective. For example, for whom is the new breed of mice from Logitech and Microsoft "better?" The new Microsoft mouse is larger and perhaps more comfortable for some, but it presents problems for those with smaller hands. Users should carefully evaluate their interfaces and devices before discarding the old for the new, improved, "ergonomic" version.

DAVID MARTIN, *via the Internet*

Finally, someone has raised an overlooked issue: The placement of function keys at the top of the keyboard instead of at the left side is simply illogical—especially considering the number of software functions using the function keys in combination with the Ctrl, Shift,

and Alt keys. Aside from Northgate (whose Omnikey keyboard has the 12 function keys on the left side), where are the keyboard manufacturers that use this more sensible keyboard layout?

PHILIP WIENER, *via PC Magnet*

THE INTERNET'S VEGAS STRIP

I couldn't agree more with the conclusion John C. Dvorak drew in his interesting column examining on-line gambling ("Gambling on a PC Near You," May 16, 1995). Indeed, we need to keep the "tax-hungry government" at bay. The problems ahead may be much worse than just taxes, though. Already there are international First Amendment questions: Can you really put up an incredibly offensive Web home page, or block one from another country? With the ever-increasing global cyberspace activity, I fear the glory days of the Internet are coming to a close and the gory days of big business and multigovernment intervention are closing in.

TRYON WELLS, *Prague, Czech Republic*

Dvorak's column on gambling was right on the money. Gambling on the Net is a growing problem, and drastic countermeasures are needed.

CARL ROTHE, *via the Internet*

THROW ME A LINE

Michael J. Miller's column "Help! I'm Drowning in Data!" (May 16, 1995) doesn't go far enough. It's ironic that at the same time that we are declaring ourselves an "information society," we're embracing a disorganized pool of electronic data, much of which is of dubious value. If we want quality information from our search retrievals, we first have to evaluate, select, identify, and index the Internet's resources.

KAREN COYLE, *via the Internet*

INTERFACE WARS

Jim Seymour's column "The Changing Face of the Interface" (May 16, 1995) exposes the myth that just because a particular program has been around for a while it is no longer useful. An interface does not become "passé" simply because it looks the same as it did in years past, and software does not become "grizzled and feeble." Software only shows its age when it no longer meets the user's needs. The software industry is in for a rude awakening if it assumes that users will buy the next upgrade just because the previous version has somehow become old.

STEPHEN CORDES, *via the Internet*

I disagree with Seymour's perspective. Of the operating systems I've tried, the Mac interface is the most refreshing and the easiest to

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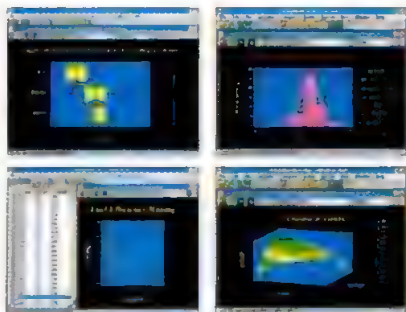
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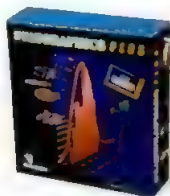
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Letters

use. It may look a great deal like the Mac interface of the eighties, but why have change for the sake of change? Except maybe in the case of Windows.

PAUL M. WOLPE, *via the Internet*

Although I agree with Seymour's conclusion that more innovative thinking should go into the design of GUIs, I don't share his opinion of the Mac interface. To me, the Macintosh operating system has always been the market leader in terms of ingenuity and ease of use.

MICHAEL KOHUT,
Yellowknife, Northwest Territories, Canada

TO EACH THEIR OWN

PC Magazine's First Looks review of InfoSeek Search ("InfoSeek Searches the Net," May 16, 1995) demonstrates the importance of case sensitivity in search engines. Had the reviewer entered the query as printed in the article, the results would have been much better. "Who are the Baby Bells?" (as printed in the article) is very different from "Who are the baby bells?" (the query actually entered). It could be argued that "The Young and the Restless" article is relevant to the query, but it wasn't what the author had intended. Search engines can't read minds—not yet, anyway.

STEVEN T. KIRSCH
InfoSeek Corp., via the Internet

WEB SERVERS 101 HONORS

Although I found the Power Programming column about Web servers interesting ("Setting Up a Web Server," May 16, 1995), the article could at best be described as introductory. It

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CORRECTIONS AND AMPLIFICATIONS

The New & Improved column in our August 1995 issue provides the incorrect phone and fax numbers for Pioneer New Media Technologies' DRM-624X 4.4X-speed six-pack CD-ROM changer. The correct numbers are: phone, 800-444-6784; fax, 310-952-2309.

The correct World-Wide Web address for PointSurvey, from Point Communications (Trends, "I Know It's Out There Somewhere . . .," August 1995) is <http://www.pointcom.com>.

Contrary to what we indicated in the introduction to our portables roundup ("Your Portable Persona," August 1995), the AMS PowerCD was not received in time to be reviewed in First Looks.

The screenshot that accompanies the First Looks review of Vizion, Version 1.1 ("Vizion Can Put Your Internet Life in Order," August 1995), is actually of MicroHelp's UnInstaller 3, which is also reviewed in First Looks.

was a fine tutorial for the complete novice, but I'd like to see articles that target readers who have more extensive knowledge of the Internet, the World-Wide Web, and HTML publishing.

HARRY MASON, *via the Internet*

800: THE ONLY WAY TO PHONE?

John C. Dvorak's suggestion that providing 800 numbers is out of date (Inside Track, May 16, 1995) is rather hasty. Rather than eliminate their 800 numbers, companies may find a better strategy if they include both toll and toll-free numbers in any mention of their business.

HILDA DENZA, *via the Internet*

IMPROVEMENT STRATEGIES

Since *PC Magazine's* service and reliability study was conducted ("Service & Reliability: Are You Getting What You Need?," July 1995) AT&T Global Information Solutions has made significant improvements in reliability, service, and support that are not reflected in the story. Since February 1995, we have made major investments to accommodate our increasing number of customers and to enhance our product reliability.

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ROB HOWE, *Vice President,*
WorldWide PC Marketing
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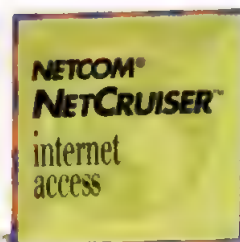
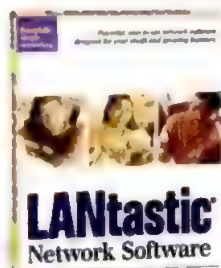
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Trends

TRENDS & TECHNOLOGY SHAPING THE PERSONAL COMPUTER MARKET

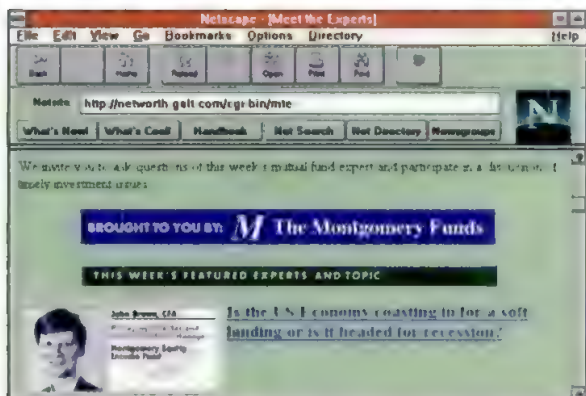
Net Worth: On-Line Investing

The Web's financial district is bustling.

Mention on-line finance and most people assume you mean electronic banking. After all, big banks and big software players—including Microsoft, Novell, and Intuit—have their sights set on that lucrative market. *Banking* has become a buzzword. But the future

of on-line finance includes much more than getting your balance and making transfers. All kinds of financial services are appearing on-line, from pork-belly trading through brokerage services to independent invest-

screen stock portfolios. In many cases, Web pages offer services you can't find in any commercial software. These pages offer a glimpse of what the future holds for all kinds of financial transactions—not just banking.



Dreyfus's Web page links to many different investment sites.

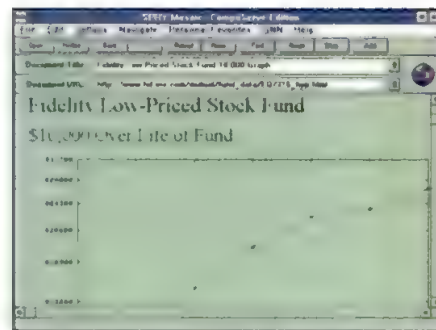
ment research. The best news is that many of the services are on the World-Wide Web—and they're free.

The Internet may provide some stiff competition for software products and on-line services as transactions go electronic. Says Reuters Money Network's Mark Goldstein: "Don't compete with the Internet in financial services—leverage it."

The Web now offers many of the functions offered in leading financial software products such as Reuters Money Network and Charles Schwab's StreetSmart. You can research the historical performance of any mutual fund, access real-time quotes, and

linked to a service called NetWorth, from Galt Technologies, where you can send questions to some of the nation's top mutual-fund managers and certified financial advisors. For example, you can converse online about the direction of interest rates with Roger Honour, portfolio manager of the top-performing Montgomery Growth Fund. Many other financial luminaries return messages through NetWorth.

Although Fidelity Investments' Web site (<http://www.fid-inv.com>) doesn't allow for Q & A with fund managers, it offers graphs depicting the historical performance of its funds and links to an extensive array of inde-



At the Fidelity Investments Web site, you can research any fund the company offers.

pendent financial services. For example, the Fidelity site links to the daily Holt stock-market reports, up-to-the-minute columns written by financial advisors, and an array of on-line financial publications.

As the Web becomes more of a commercial entity, it's inevitable that many of the financial services found there will become fee-based. At Lombard Brokerage's Web site, premium services are strictly distinguished from free services. Account owners can access real-time quotes and research, while others can access only delayed information. As the Internet goes commercial, much of its content could follow this model.

While banking isn't the only branch of the financial services sector headed on-line, competition is heating up there. Intuit recently announced partnerships with over 20 major banks, including the Bank of Boston and Chemical Bank. Notably, several of the banks in partnership with Intuit are also aligned with Microsoft Money.

—Sebastian Rupley

A screenshot of the Lombard Institutional Brokerage website showing real-time stock quotes for Intel Corp. The page includes a table with the following data:

Intel Corp			
Last	116 1/8	Change	1
Volume	7,650,700	Date/Time	06/16/95 18:42:32
Bid	116	Ask	116 1/8
Bid Size	0	Ask Size	0
Option Symbol	INTQ	Option Chain	
Exchange	NASDAQ	Symbol	INTC
Open	115 1/2	Prev. Close	115 1/8

The Lombard Institutional Brokerage Web site offers extensive investment research.

Pipeline By Jake Kirchner

Buddy, Can You Spare A Megabyte?

I ran into Donald Trump recently. He was coming out of the Plaza Hotel (he still owned it at the time, along with about half the East Coast). I was trying to get a cab after searching midtown Manhattan for a deal on a new hard disk for my home PC. Donald—if I may be so personal—dashed toward a limo as I gave up on a cab and ducked into the subway. As I fished for a token, I thought, “Okay, so the guy has more closets than Imelda Marcos, but I wonder how much data storage he has.”

Speaking of real estate, by now you should have recognized the launch of Windows 95 as the cannon shot setting off the largest data-storage land rush in computing history. Given the size of Windows 95 and the new 32-bit apps rolling out right now, you can expect that 1-gigabyte hard disks soon will be as common around your office as Post-It notes.



Of course, chances are that this won't be the first time you've gone hard disk hunting. You've probably already moved up from your condo-size PC to that suburban starter-home system with at least 300 or 400 hundred megabytes of hard disk capacity. You'll be needing even more with Windows 95. Fortunately, you can add half a gigabyte or so without taking out a second mortgage. A couple hundred bucks will take care of it. Pocket change for the Donald.

The downside of this data-storage trend is that it doesn't seem likely to end. For many users, the siren song of the big-number Pentium processors falls on deaf ears, but the desire for more

storage seems insatiable. It's gotten to the point that many people are upgrading their entire systems when they need more disk space. While they're adding disk capacity, they figure they might as well add the faster processor and multimedia enhancements.

Sit tight; help is on the way. This fall, a number of systems vendors will start offering rewritable CD-ROM drives. First to hit the market will be the new PowerDrive from Panasonic. Developed by its parent corporation, Matsushita, Panasonic's drive is a combination quad-speed CD-ROM player and rewritable CD-ROM drive. It will play your data and audio CDs as well as record a full 668MB of data on a \$60 blank CD cartridge. You can use each rewritable CD over and over and record more than 1GB of compressed data.

Panasonic is touting its new drive as perfect for those who are going to buy a CD-ROM drive anyway and who also are interested in backup but think of tape drives as the province of gear heads. With an initial list price of \$895 for an internal drive and \$995 for an external version, the PowerDrive won't add more than \$300 or \$400 to the cost of your next computer, since you're saving the cost of the standard CD-ROM drive you would have bought otherwise. And Panasonic promises to cut the street price to half the initial list price within a year.

More importantly, the drive is just the first of a new generation of media—some optical and some magneto-optical—that in the next couple of years may supplant the current magnetic hard disks. Anyone who's looking for a couple more acres of storage will welcome the development of the various writable, rewritable, and removable media coming from the world's major storage manufacturers.

Best of all, with the PowerDrive sure to arrive soon in the *PC Magazine* offices, I betcha I'll have one before Donald does.

Jake Kirchner is the editor of PC Magazine.

Flat-Out Display Improvements

WITH ALL THE TALK ABOUT HOT new flat-panel technology, it's easy to think that CRT (cathode-ray tube) monitors are just the same old same old. New developments, however, will help maintain the dominant position CRTs now hold.

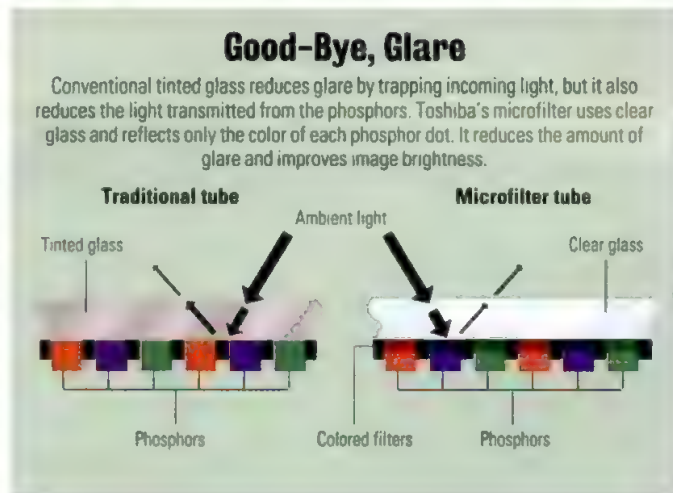
Panasonic has developed a new picture-tube design, dubbed “pure flat.” While most monitors today use a curved face, the Panasonic design has an essentially flat front face that greatly reduces glare. This is a departure from even “flat square” tubes, which are curved in both the vertical and horizontal dimensions. Mitsubishi Diamondtron and Sony Trinitron monitors are flat in the vertical dimension but curved horizontally.

Not since the ZDS monitor of

years ago has there been a tube with a flat face. The Panasonic tube has a wider deflection angle than the ZDS design, so it's only about as deep as a standard monitor. The

tubes can be built on a standard CRT fabrication line, and while there will be a small additional cost in manufacturing them, there may be little or no difference in cost to consumers when compared with traditional monitors.

Other advances, such as Toshiba's microfilter design, are more evolutionary. Before Toshiba developed this process, manufacturers alleviated glare by using special coatings and tinted glass—but these techniques also reduced brightness and contrast. Toshiba puts a tiny colored filter over each phosphor dot. Any reflected light bouncing off the filter is absorbed, except for the color of the underlying phosphor. As a result, the tubes can use clear glass, instead of tinted. Based on Toshiba's tests, the new tubes are up to 37 percent brighter than conventional tubes, with 17 percent more contrast. Toshiba plans to start volume production of microfilter tubes later this year.—*Alfred Poor*



LCD Panels: Made in the U.S.A.

YOU MAY NOT BE ABLE TO HEAR A great sucking sound in Tokyo yet, but there are a few good reasons why U.S. companies may be able to take back a share of the booming LCD manufacturing market from Japan.

First, the yen is now expensive compared with the dollar, giving home-grown panels a cost advantage. Second, American companies are finding ways to automate the production process significantly, which reduces the impact of higher U.S. labor costs on the final product. LCD fabrication has been a labor-intensive process to this point.

One such company is PRI Automation, of Billerica, Massachusetts. PRI has built automated fabrication equipment for the semiconductor industry, with more than 1,000 systems installed worldwide. Where traditional fabrication facilities require large areas maintained under exacting clean room-environment conditions, PRI makes robotic systems that keep the materials in small enclosures. This spring, PRI introduced a new model, the 360-Degree Machine Loading Robot, designed to han-

dle up to 600- by 720-mm glass—more than four times as large as the typical semiconductor silicon wafer, and large enough for LCD panel fabrication. In addition to cutting labor costs and the expense of maintaining highest-level clean-room conditions on a larger scale, these robots also reduce the chances of worker injury and human error. Contamination or breakage of a single cassette of panel displays can mean a loss of \$250,000 or more to the manufacturer.

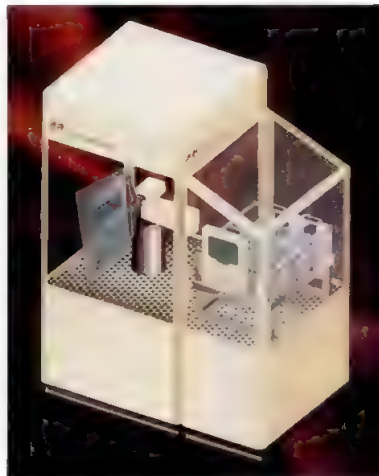
There are other signs that U.S. manufacturers are gearing up to get more involved in LCD panel fabrication. Three-Five Systems, of Tempe, Arizona, has announced the open-

ing of a new production facility for passive LCD panels. Three-Five Systems is one of the leading producers of smaller LCDs, such as those used in pagers and cellular phones, and

initially the new plant will be used to manufacture these devices. In addition, the facility is designed to handle up to 365- by 465-mm glass for LCD panels, and it has a capacity to produce up to 40 million square inches of glass a year—enough for 800,000 notebook PC display panels.

Three-Five Systems is quick to point out that this plant was funded through its own efforts; no federal grants were involved. On the other hand, although the plant is highly automated, the

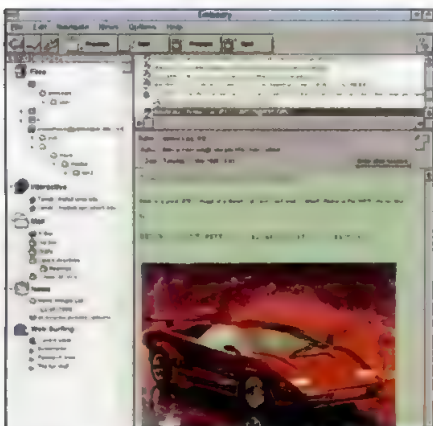
final component assembly is still a labor-intensive operation, and the finished components are shipped from the factory to an assembly plant in the Philippines for this last step.—*Alfred Poor*



PRI Automation's 360-Degree Machine Loading Robot can manufacture both silicon wafers and flat-panel displays.

Internet Suites

NEW NETIZENS DON'T WANT THE Internet to be a technological challenge. They simply want software to work well and to work together. They want all their tools for e-mail, FTP, Gopher, telnet, and the



Emissary puts your Internet tools in one place.

World-Wide Web in one place. They don't want six different programs with six different interfaces all running at the same time.

Software publishers are working to make life on the Internet easier with browsers that provide full or partial integration among

various tools. Some packages are available now, and others are making beta rounds on the Internet.

And just how integrated is integrated? In The Wollongong Group's Emissary (<http://www.twg.com>), integration is complete: Every Internet tool, including e-mail, FTP, newsgroups, and World-Wide Web, is accessible from a single application. NCD's Mariner (<http://www.ncd.com>), available this fall, also promises complete integration. California Software's InterAp (<http://www.calsoft.com>) also makes several tools—including e-mail, FTP, Gopher, and newsgroups—accessible from its Web browser. It has an application launch pad and supports applications integration through OLE 2.0. Quarterdeck's InternetSuite (<http://www.qdeck.com>) and MegaWeb's GNN Works (<http://www.megaweb.com>) offer limited integration, in which separate programs for Web browsing, e-mail, and newsgroups are linked via menu commands and toolbar icons.

"Users are getting sick of all those icons on the desktop," says Samir Shah, product engineer for The Wollongong Group. "We've been focusing on one user interface, one application, one window, and one icon on the desktop, and the reaction has been very positive."—*Neil Randall*

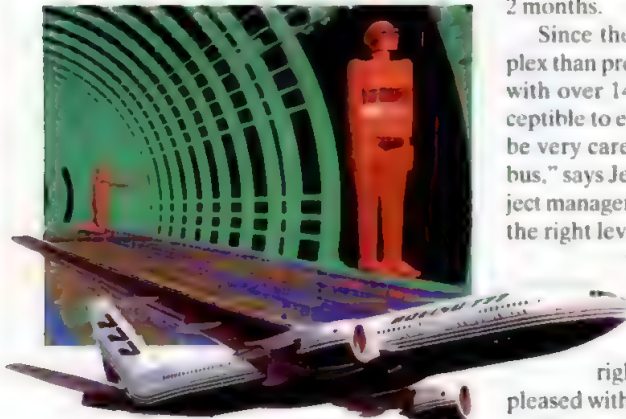
Top Retail Software

Current ranking	Last issue	Product/company
1	8	WordPerfect 6.1 for Windows Upgrade Novell Inc.
2	2	Procomm Plus for Windows 2.11 Datastorm Technologies Inc.
3	—	WinFax PRO 4.0 Delrina Corp.
4	10	Netscape Navigator Personal Edition Netscape Communications Corp.
5	7	MS-DOS 6.22 Upgrade Microsoft Corp.
6	—	Sticky Notepad 1.0 Digital Systems Research
7	—	SoftRam Synchronys Software
8	—	Magna RAM Landmark Research
9	4	Internet in A Box 2.0 CompuServe Internet Division.
10	—	QEMM 386 7.5 Quarterdeck Corp.

This list ranks PC business programs according to the total number of copies they shipped to over 12,000 stores and resellers in the week ending July 1, 1995. The list cannot be interpreted as a picture of the entire software market. Adapted from a compilation by Ingram Micro.

Virtual Prototyping: New Tools to Build New Products

THE BOEING 777 WAS BUILT FIRST as a virtual airplane, existing only on a computer program called FlyThru. The Miami International Airport exists as a computer simulation built by Lockheed Martin.



Boeing engineers used 3-D visualization software to simulate assembly of the new 777.

Hewlett-Packard runs simulations of its motherboards before they're built. And Motorola constructs virtual prototypes of cellular phones.

Picking up where computer-aided design software leaves off, virtual prototyping software simulates not just the way things look but also the way things work. Increasingly, manufacturers are turning to simulation for a number of reasons: to cut down on the number of actual prototypes they need to build, to shave months off design schedules, and to make better products.

When time-to-market is as crucial as it is in the PC business, and when product lifetimes are measured in months, new tools are helping companies keep up with the frantic pace. At Hewlett-Packard's person-

al computer R & D lab in Grenoble, France, engineers designing motherboards for Intel's upcoming P6 microprocessor have developed simulation software that has reduced the 9-to-12-month design cycle by 2 months.

Since the P6 is significantly more complex than previous chips, has a fast, wide bus with over 140 different signals, and is susceptible to electrical crosstalk, "you have to be very careful about noise margin on this bus," says Jean-Marc Laugenie, R & D project manager at HP. "We think it is key to do the right level of signal integrity simulation to make sure we are routing the bus right. We have made several routing experiments to make sure that we have the right signal shape, and we're really pleased with the latest results."

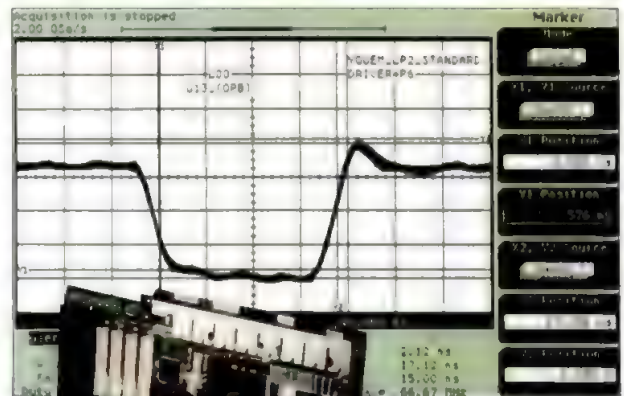
By observing the simulation of a working motherboard on a computer screen, the HP team has been able to experiment with different designs, identify bottlenecks, and make corrections (such as making traces wider and using different materials) before building prototypes. The net result: HP has cut two prototypes—and much time—out of its design cycle. "By the time you identify all the changes, implement them, and load the components onto the board, a full-blown PC board takes over a month to construct," explains Laugenie.

For HP, the simulation software has not only saved time but also produced a better motherboard. "In our last design, we ran some extensive simulations on the PCI bus and were able to go beyond the arithmetic limits and support four PCI slots. Without simulation, we would have been limited to three PCI slots," says Laugenie. HP engineers also use the simulations to design "margin" into systems, which insures that the

motherboards can handle variations in microprocessor performance. "By making sure we have the right signal shapes through simulations, we can push frequency higher." During a *schmoo* test, they push the board to the limit and predict the effects of increased frequency and temperature and lower voltage.

While HP is using RISC-based workstations to run the simulations, other companies are running simulation software on PCs. A distant cousin of authoring tools such as Director and Toolbook, virtual prototyping software on the PC goes beyond these programs; it actually models functional behavior and enables free-play simulations.

"Everything that's designed on paper will work perfectly on paper," says Meir Morag, vice president of marketing at Emultek, an Israel-based software company that developed Rapid, a Windows-based prototyping

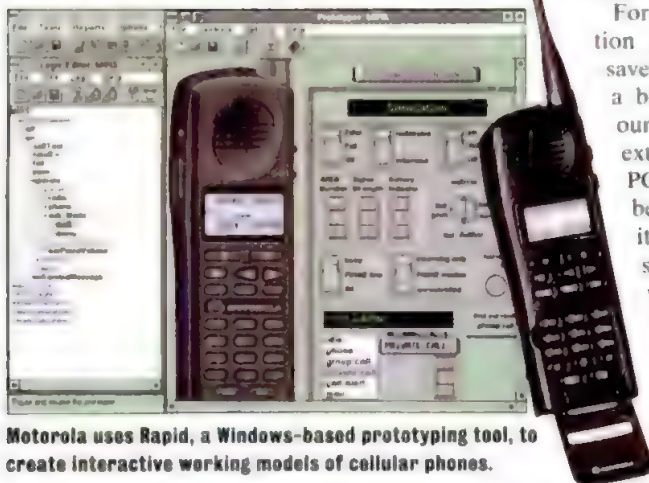


By simulating a P6 motherboard, HP engineers eliminated two prototypes.

package (in the U.S., 203-891-8495). Seated at a computer displaying a working prototype of a

product designed with Rapid, a user can try out features and provide feedback that can be quickly implemented. Engineers at Motorola use Rapid to design the interface of some cellular phones. Nokia and Philips use it to create working models of new consumer electronics products.

Designed initially to simulate the cockpit of fighter jets, Rapid is branching out beyond industrial design. Businesses now are building Rapid simulations into computer-based training applications to give trainees practice with the real thing, or close to it.—Carol Levin

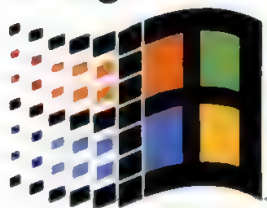


Motorola uses Rapid, a Windows-based prototyping tool, to create interactive working models of cellular phones.



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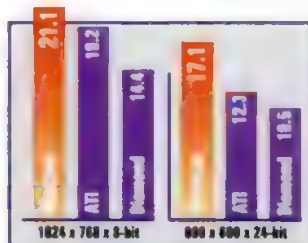
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Windows 95 tests (Bench 501) conducted by Matrox Graphics Inc. using 200 MHz Windows 95 on a Gateway P100 system with 256 cache, 16MB RAM at 1024 x 768 in 256 colors (large fonts) and 800 x 600 in 16.7 million colors (small fonts) 72 Hz. The Matrox MGA Millennium, Diamond Stealth 64 and ATI Graphics Pro Turbo were configured with 2 MB of memory for the PC but using driver releases 2.00.001, 4.00.001 and 4.00.001 respectively.

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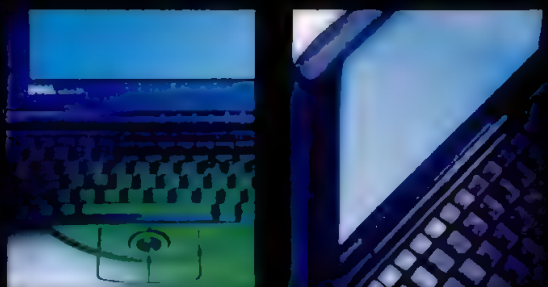
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*The VeriTest Cross-Country v2.0 test simulates typical executive use of Microsoft Office® applications in Microsoft Windows® 3.11 during an airplane flight. Power management was enabled and 8MB RAM was installed. VeriTest, Inc. is located in Santa Monica, CA. Promotional pricing featured is not discountable. *Guarantees available in the U.S. only for registered owners of Dell Latitude systems purchased after 8/9/94. For a complete copy of our Guarantees or Limited Warranties, please write Dell USA L.P., 2214 W. Braker Lane, Building 3, Austin, TX 78758. †Business leasing arranged by Leasing Group, Inc. *Prices and specifications valid in the U.S. only and subject to change without notice. The Intel Inside logo and Pentium are registered trademarks and Intel DX4 is a trademark of Intel Corporation. ©1995 Dell Computer Corporation. All rights reserved.



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First Looks

HANDS-ON REVIEWS OF NEW SHIPPING PRODUCTS

COLOR PRINTERS

HP DeskJet 1600C Is a Midrange Masterpiece

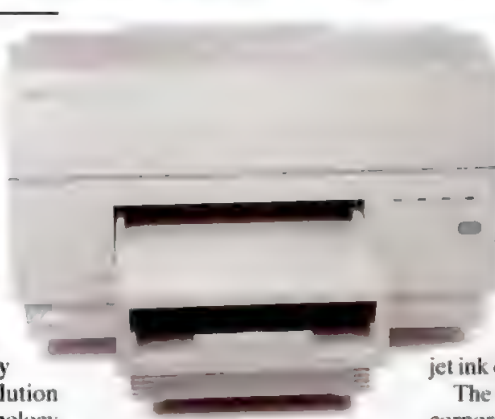
By Alfred Poor

If you want an all-purpose office color printer that can tackle many jobs well at an affordable price, look no further than Hewlett-Packard's new HP DeskJet 1600C, an ink jet color printer. The HP DeskJet 1600C's virtues include the ability to produce black-and-white text pages quickly and to print high-quality full-color images, regardless of whether the printer is connected to a network or a single PC. But for many, the best part is that at \$1,699, the 1600C produces better print quality than the slew of personal color ink jet printers on the market, yet costs far less than any color laser printer. The PostScript-equipped and network-ready model we tested, the HP DeskJet 1600CM, sells for \$2,479.

Like the \$1,249 HP DeskJet 1200C, the 1600C is a PCL-based page printer that uses a separate cartridge for each of the four ink

colors; the system uses black, cyan, magenta, and yellow inks. The 1600C offers 600-dot-per-inch resolution with resolution enhancement for black-only output, and 300-dpi resolution with HP's ColorSmart technology for color output.

The high resolution and edge smoothing used for black text yields output that rivals the print quality produced by most monochrome laser printers—even when the 1600C is using plain



COLORFUL COMPANION: The HP DeskJet 1600CM adds PostScript and networking to a good all-around ink jet printer.

photocopier paper instead of expensive coated ink jet stock. The reason is that HP has reformulat-

ed the black ink to make it darker and more smear-resistant.

The result is that black regions are solid, smooth, and well filled in. While—like other ink jet printer output—the ink still can have a tendency to smudge slightly if you get it wet, it is far more smudge-resistant than most ink

jet ink output.

The Windows driver, which incorporates the ColorSmart technology, makes it easy for users to match the DeskJet 1600C's capabilities with the design of the page being printed. The driver is able to distinguish automatically among three types of output—text (black

Continues on page 38

SQL DATABASE SERVERS

Microsoft SQL Server 6.0 Eases Database Management

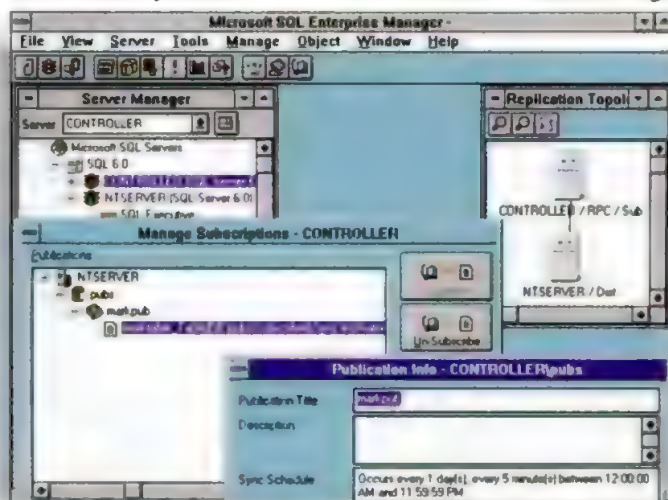
By Mark Jonikas

By providing a high-performance database program with management software and a replication server in a single aggressively priced package, Microsoft SQL Server 6.0 (SQLS) takes a step forward from its predecessor, Version 4.21. The database system is supported on Intel, MIPS, and Alpha platforms running Microsoft Windows NT and makes full use of symmetric multiprocessing for up to four CPUs.

SQLS's Transaction SQL complies with the ANSI 89 and ANSI 92 standards and includes further enhancements such as the CASE statement. It now supports declarative referential integrity, although you will still need to use triggers to cascade updates or deletes.

A new category of extended stored procedures gives access to external mail and log functions. The query optimizer has been improved (especially in its handling

of complex subqueries) and now accepts hints to specify a preferred index or join order.



GETTING SUBSCRIPTIONS: The replication topology window supports drag-and-drop for establishing subscription servers.

More parameters are available for tuning the database engine, particularly the read-ahead feature, lock escalation, and tempdb

database. Read-ahead and buffer management redesign probably account for the throughput improvement seen on our benchmark tests. When a page is requested, a pool of threads acts asynchronously to pull in a number of the pages that follow. This allows SQLS to maintain a high

level of cache hits, offering significant advantages for large table scans. A target cache hit level can

Continues on page 39

IN FIRST LOOKS

Fauve xRes	40
trueSpace2	40
DeltaGraph Pro 3.5	42
WinFax Scanner	42
Audiotrix Pro	44
Vivid3D Speakers	44
Remove-IT	46
3D Fax Professional	46
Conversions Plus 3.0	47
PCTeX for Windows 2.0	47
TrueTeX for Windows 4.0	47
IBM VisualAge C++ for OS/2	48
ELSAMotion	48
Helix Hurricane	50
MagnaRAM	51
Quicken Financial Planner	54
WinSales 3.0	54
Boris 1.0	56
HotelDisk 1.0	56
Netscape Navigator Personal Edition	56

First Looks

HP DeskJet 1600C

Continued from page 37
characters), business graphics (spot color), and photographs (scanned images with shading or continuous tones)—and format the output accordingly.

You can let the driver make selections for you, or you can manu-

ally choose your own settings for each page. The choices include Vivid Color, Match Screen, or No Adjustment. If you choose Match Screen, you'll want to use the built-in screen-calibration software that comes with the printer. Screen calibration takes about a minute to complete, and it does a good job of matching the screen's color to the printed image.



THE SKY'S THE LIMIT: The output of the HP DeskJet 1600C has rich and saturated colors, no banding, and good balance.

ally choose your own settings for each page. The choices include Vivid Color, Match Screen, or No Adjustment. If you choose Match Screen, you'll want to use the built-in screen-calibration software that comes with the printer. Screen calibration takes about a minute to complete, and it does a good job of matching the screen's color to the printed image.

The 1600C offers several different dither patterns: Cluster, Pattern, and Scatter (also known as *diffused* or *random pattern*). During our evaluation, we found that the Cluster and Scatter halftone settings produced the best results for photographs.

PRINTER-SPEAK

The driver communicates with the printer via the bidirectional high-speed parallel interface. This allows the printer to detect a range of error conditions—including running out of ink in any of the four individual ink cartridges—which are then reported on your computer's screen.

The HP DeskJet 1600C also comes with a DOS-based utility

ample, when the printer is powered up and on-line, the button performs a self-test and prints a status page. It also serves as a form-feed control, a manual-feed override, and a resume button.

The 1600C's paper-handling options are limited but adequate. The main paper tray holds up to 180 sheets of paper, but the paper path follows a tight 180-degree turn that flips the paper over on its way to the print mechanism. For that reason, labels and heavier stock should be fed through the manual-feed slot in the back of the printer, which has a paper path that comes closer to a straight line. You can also use this slot to feed envelopes, one at a time. If you need a larger paper supply, you can add the \$379 500-sheet tray, which sits under the printer.

We tested the HP DeskJet 1600CM, which includes PostScript and Ethernet, along with AppleTalk network-interface cards. It also boosts the 1600C's standard 4MB of on-board memory to 6MB. While both units are controlled by the same 32-bit Intel RISC processor, which op-

erates at 20 MHz, the 1600CM provides automatic language switching between PCL and PostScript. HP rates the printer at 8 to 9 pages per minute (ppm) for black-and-white text. On our printer speed tests, the HP DeskJet 1600CM was able to print at a rate of 8.5 ppm.

We found that the color output of the printer was as good as the pages produced on many color laser printers. Colors were bright and well saturated. The best results were obtained using the printer's Vivid Color setting to print on coated stock paper. Overhead transparencies were quick and easy to produce, with clear and crisp colors. There was no evidence of banding in any of our test image prints.

When it comes to the cost of consumable items, the HP DeskJet 1600C is a reasonable choice for everyday use in an office setting. According to estimates from HP, black-and-white output at 5 percent coverage (typical for a page of text) will cost about 1.5 to 3 cents per page, depending on print mode, which is on a par with most laser printers.

Color is not much more expensive to produce; 15 percent page coverage is estimated to cost between 3.3 and 6.5 cents per page.

yields draft prints that can cut ink costs in half.

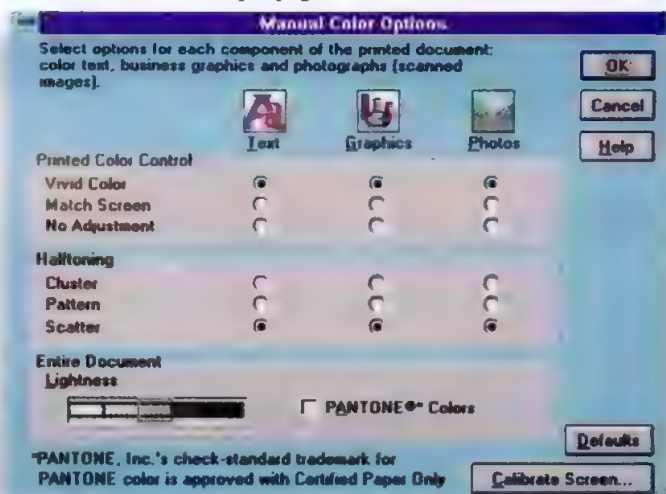
HP backs the printer with a one-year parts-and-labor warranty that includes HP's Express Exchange service, providing for overnight replacement of a printer that fails under warranty.

COLOR HYDRA

The next step for HP is to incorporate the 1600C's print mechanism with the HP ScanJet 3c's 30-bit color scanner (First Looks, May 16, 1995). This would produce an extremely capable all-in-one color image center for scanning, printing, and copying. Look for this system to be available soon, and to cost about \$2,500.

As far as the HP DeskJet 1600C is concerned, you get a printer that sits between major market segments. Its text quality rivals that of many black-and-white laser units, and its color abilities push into the range of much more expensive color laser printers. The base price is \$1,699. To do better than this you'd have to spend three or four times as much.

HP DeskJet 1600C. List price: With 4MB RAM, \$1,699. **HP DeskJet 1600CM.** List price: With PostScript, Ethernet, 6MB RAM, \$2,479. Consumables: Black-ink



CUSTOMIZE: The HP DeskJet 1600C's options include color control, half-toning, and color calibration.

That's roughly equivalent to printing a solid 3- by 5-inch image on a letter-size page. For those who are in a hurry, or who need to proof work, the printer also has an EconoFast print setting, which

cartridge, \$32.95; color-ink cartridge (cyan, magenta, or yellow), \$34.95. Hewlett-Packard Co., Direct Marketing Organization, Santa Clara, CA; 800-752-0900. Circle 439 on reader service card

SQL Server 6.0

Continued from page 37

be set manually and SQLS will adjust the read-ahead to maintain that level.

SQLS's lowest level of locking is still the page level rather than row level, but the database administrator can now specify the threshold at which a series of page locks will automatically escalate to a table lock. It is now possible to set aside a part of RAM for the tempdb database, which will speed up transactions.

SQLS now supports scrollable cursors, which will make it easier for programmers coding decision support systems. Also, SQLS supports parallel load and dump, so multiple parallel tasks can be set off simultaneously. This is an important feature for speeding the backup of larger databases.

MANAGEMENT TOOLS

The real key is SQLS's Distributed Management Framework (DMF), which is made up of three major components: SQL Enterprise Manager, Distributed Management Objects, and SQL Executive.

SQL Enterprise Manager is a graphics-based administration tool for managing multiple SQLS databases. Using a hierarchical outline, the administrator can configure, monitor, schedule, back up and restore, and manage security as well as set up replication. Nearly all aspects of database creation, from the specification of devices to table and index setup, can be performed graphically with this tool, giving the administrator a visual understanding of the use and availability of resources. One surprising omission, however, is the lack of a bulk copy interface.

SQLS's Distributed Management Objects component consists of objects and properties for SQL management and administration, which can be accessed via OLE. These objects are available for use with Visual Basic, giving an administrator flexibility in managing multiple database tasks with a few lines of code.

The third component, SQL Executive, is a Windows NT service that implements the tasks defined

by SQL Enterprise Manager and Distributed Management Objects.

SQLS's replication is implemented as a loosely consistent model. Although this will sometimes leave a small consistency gap between the master and the destination database, it avoids the performance hit of a tight-consistency model. Replication is established by means of a distribution database. This is a clearinghouse which is fed by the master database transaction log and which in turn sends replication data to target databases.

server receiving replication data from multiple sites.

The basic unit of replicated data is called an *article*. The administrator defines an article by selecting a publication table, which can be edited to replicate only columns or rows. Once the subscription is established, the administrator can define whether the destination table is to be synchronized automatically or manually.

SQL Enterprise Manager's interface makes the setup of replication easy to establish and manage, although a few additional

and more stations (up to 60 clients). The tests (which were done on a Compaq ProLiant 4000 with 128MB of RAM and one, two, and four Pentium/66 CPUs) bore out SQLS 6.0's superiority over Version 4.21.

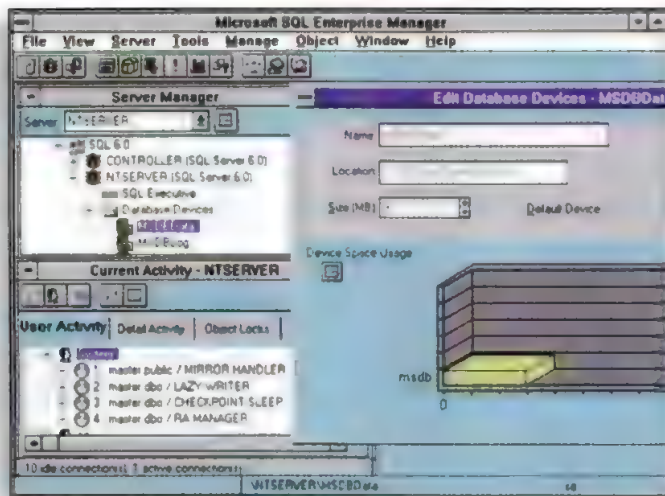
In the single-CPU configuration, an initial improvement of up to 67 percent (relative to Version 4.21) fell off as the benchmark test became CPU-bound at loads beyond 8 workstations. With two CPUs, the performance improvement was maintained at all workloads, peaking at 141 transactions per second (tps) with 12 workstations—a 12 percent improvement over Version 4.21. With four CPUs, the throughput peaked with the same workload at 172 tps, a 21 percent improvement over Version 4.21.

Scalability has improved as well. With a load of 12 stations, moving from one to two processors improved SQLS 6.0's performance by 61 percent. Moving to two processors improved Version 4.21's performance by only 42 percent. Moving from two to four processors, SQLS 6.0's performance improved by 22 percent, compared with Version 4.21's 13 percent improvement.

With impressive performance, ease of administration, and a replication server, Microsoft SQL Server 6.0 is a package other database vendors will find hard to match. SQLS 6.0 will no doubt further the acceptance of the operating system Windows NT at the enterprise level. Database servers, however, are no longer islands. Most database engines currently reside in the Unix and mainframe environments. And while SQLS 6.0 can interface with them via the Open Data Services gateway, the administration tools and replication server will need to establish links to these environments if they are to become more widely accepted.

Microsoft SQL Server 6.0. List price: Single-user license, \$149; 20 or more users, \$119 each; server license, \$999. Requires: 16MB RAM, 35MB hard disk space, Microsoft Windows NT 3.5 or later, CD-ROM drive. Microsoft Corp., Redmond, WA; 800-426-9400, 206-882-8080.

Circle 436 on reader service card



WATCHFUL EYE: SQL Enterprise Manager gives an administrator a visual handle on activity and available database resources.

The distribution database is set up within SQL Enterprise Manager by selecting a server and using the Install Publishing command. This allows the distribution database to be set up either locally or at a remote site, which reduces the load on the main server. By selecting the Publishing menu option, the administrator specifies which databases are authorized to publish data and which servers are authorized to receive replicated data together with the replication schedule. Data can be replicated continuously or at specified intervals (such as nightly).

When a server requests a publication it becomes a subscriber. A *push subscription* originates at the master server and simplifies administration of replication to multiple sites. A *pull subscription* from the destination server simplifies administration for a single

SQL commands still have to be entered manually to establish remote log-on access and to set up constraints on a table whose data is to be replicated. When there was no traffic on the network, a short series of tests using default parameters showed a row of data inserted on one server replicated on another server in 5 seconds. At present, replication is supported only among servers using SQLS 6.0.

SQLS 6.0 PERFORMANCE

We performed comparison tests on a four-table 2.5GB database. The tests consisted of a mix of five transactions: a small select, a large join, an update in place, an insert, and a delete. Less weight was given to the large join and the delete. We sent these transactions from 1 station for 10 minutes and calculated the throughput. This was repeated on 4, 8, 12,

3-D GRAPHICS

trueSpace2: 3-D Modeling for the Masses

By Luisa Simone

Caligari's \$795 trueSpace2 is a program with a mission: to make 3-D modeling and animation accessible to everyone. Instead of learning a complicated command structure, users work with nearly self-explanatory icons and can reshape objects directly.

The big news in trueSpace2 is the inclusion of Intel's 3DR technology, which delivers real-time rendering; allows the user to work with solid, shaded objects, complete with lighting effects and surface textures instead of wireframe models; and provides instantaneous feedback. Equally impressive are the new free-form deformation tools. Gone is the rectangular deformation lattice that put a barrier between you and the object you were manipulating. The new Sculpt Surface and Deform Object tools let you mold on-screen objects as if they are clay, because the geometry of the object can be directly pushed, pulled, scaled, and rotated.

trueSpace2's 3DR rendering is a close but not exact match to the final rendered scene, however. At the moment, neither bump maps nor transparency effects can be rendered interactively. And if you rely on a software-only implementation of Intel's 3DR technology, you'll find yourself restricted to viewing and editing solid objects in a smaller window.

For the more technically inclined, trueSpace2 adds several precision modeling tools, such as live dimensioning and numerical inputs for primitive shapes. Boolean operators can create complex geometry easily. Functions such as Union, Intersection, and Subtract let you fuse, chisel, and drill objects with other objects.

With all of these new modeling features, it's easy to overlook the improvements to the animation and rendering engine in trueSpace2. Using keyframe animation techniques, you can change the surface properties and transparency of objects and modify environmental variables such as fog and lighting. You can even render

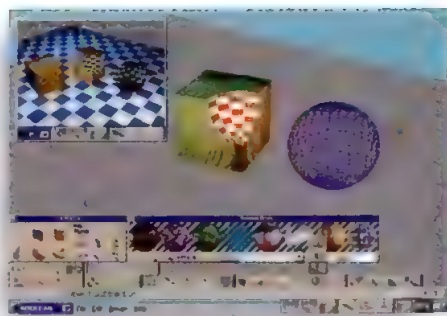
still images and animations with creative effects, thanks to the addition of support for Adobe plug-in filters. Five sample filters from Kai's Power Tools let you experiment with effects such as Pixel Wind and Soft Edges.

Although trueSpace2 still supports only TrueType fonts directly, you can use Type 1 fonts via the PostScript interpreter that can import both fonts and vector outlines from .EPS and PostScript printer files. New export options include the Autodesk .FLC format, JPEG-compressed files, and field

rendering for true NTSC or PAL video output. trueSpace2 includes a CD-ROM containing hundreds of 3-D objects and bitmapped textures.

trueSpace2 stands alone as the only high-end 3-D modeling and animation program that nonengineers can truly master.

trueSpace2. List price: \$795; upgrade, \$149. Requires: 8MB RAM, 10MB hard disk space, Mi-



MIX 'N' MATCH: Boolean operations can combine not just shapes but textures as well. The smaller window is rendered with 3DR technology.

crosoft Windows 3.1 or later. Caligari Corp., Mountain View, CA; 800-351-7620, 415-390-9600; fax, 415-390-9755.

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GRAPHICS SOFTWARE

xRes: The Image-Editing Timesaver

By Daniel Grotta and Sally Wiener Grotta

Fauve's \$799 xRes program can speed up the frustrating and time-consuming process of editing a large image file in Adobe Photoshop or Micrografx Picture Publisher by working only on the pixels displayed on

plug-in filters, and it offers natural media-art brushes and textures that are customizable. The program uses two new file formats: Images are saved in an .LRG format, and the editing commands are kept in an .XRS file.

Converting images into xRes's native format takes time. For in-

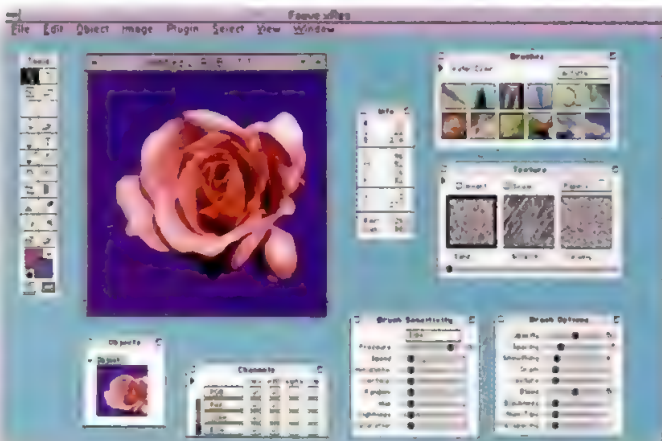
convert some JPEG files; Fauve is working on fixing the problem.

The beauty of xRes is that editing can be performed virtually in real time on any size file. Masking and channel operations in xRes are versatile and precise. The curves dialog box, which includes five different editing profiles, is the best we've seen.

The program offers good prepress features, and xRes's editing tools work on both CMYK and RGB files. Conversion tables can be edited manually or by using a ColorTron spectrophotometer; GCR/UGR black values are adjustable any time, using a filter.

Amazingly, xRes has no Print command. To output your work, it must be converted to a traditional format and exported to another program; Fauve will remedy this flaw in xRes 2.0. For the best performance, Fauve recommends that you reduce your swap file—which may interfere with the configuration of other graphics programs—to a minimum.

xRes is an image-editing power tool that speeds up working with large graphics files and augments, rather than replaces, Photoshop or Picture Publisher. **xRes 1.2.** List price: \$799; Adobe Photoshop upgrade, \$199. Requires: 16MB RAM (20MB recommended), 8MB hard disk space, Microsoft Windows 3.1 or later. Fauve Software Inc., San Francisco, CA; 800-898-2787, 415-543-7178; fax, 415-543-5148. Circle 413 on reader service card



QUICK EDIT: Fauve's xRes works on only the part of the image that is on-screen, speeding up image editing.

your monitor. After editing, xRes applies all the changes made on-screen to the entire file. We found that using xRes reduced image-processing time to one-fifth the time required by conventional programs.

xRes provides a familiar, Photoshop-like interface that supports Photoshop-compatible

stance, a 36MB TIFF image took 44 seconds to open in Photoshop but required 3 minutes 23 seconds to open in xRes. But once it was converted to .LRG format, it could be opened in about 5 seconds. There is no utility to perform batch conversions. During testing, xRes produced application errors when attempting to

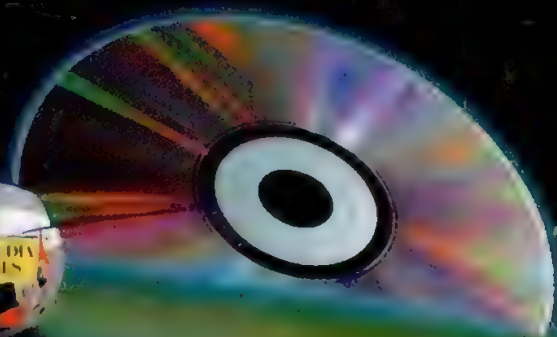
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SCANNERS

WinFax Scanner Places Software At the Center of Attention

By Bruce Brown

During the past year, several companies have introduced compact convenience scanners that process paper documents for optical character recognition (OCR), image editing and storage, and document processing. Typically, these units—which include the Logitech PowerPage, Plustek ScanFX, Umax PageOffice, and Visioneer PaperPort—come with document management and faxing software. The \$299 Delrina WinFax Scanner turns this arrangement around by making the company's popular WinFax PRO 4.0 software the centerpiece of the product.

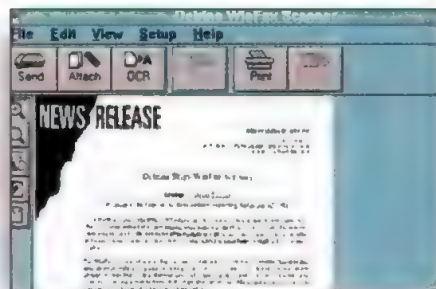
The WinFax Scanner bundle includes a 3.5-pound, 11.5-by-4.2-inch Fujitsu scanner with a 10-

device so you can still use the parallel port to print.

The WinFax Scanner works with your fax modem for sending and receiving faxes. When the WinFax Scanner application is running, a sheet of paper inserted in the device is automatically fed through the unit and scanned in about ten seconds. You can configure the software to automatically perform OCR or invoke WinFax PRO for faxing. Resolution ranges from 150 to 300 dots per inch, and the unit can scan 1-bit black and white, as well as 64-level

and 256-level gray-scale images. Once pages have been scanned, the image can be saved in any of several major file formats, including .BMP, .PCX, .TIFF, and .JPEG. Scanned paper sizes can range from business card to legal-size pages.

Among the paginated scanners available, the Delrina WinFax Scanner is the easiest way to fax paper documents. But it is still not as simple to use as a standalone fax machine. If you're tight on space, Delrina's WinFax Scanner can give your office a one-two scanner/faxing punch. **Delrina WinFax Scanner. Estimated**



SCAN OR FAX: Depending on how it is configured, Delrina's WinFax Scanner can automatically fax or scan pages.

ated street price: \$299. Requires: 8MB RAM, 17MB hard disk space, fax modem, DOS 5.0 or later, Microsoft Windows 3.1 or later. **Delrina Corp., San Jose, CA; 800-268-6082, 408-363-2345; fax, 408-363-2340.**

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SPREADSHEETS

DeltaGraph: Lots of Graphing Choices for the Mac and PC

By Craig Stinson

Like competitors Software Publishing Corp. (Harvard ChartXL) and Trimetrix (Axum), DeltaPoint's \$195 DeltaGraph Pro 3.5 is an accessory for spreadsheet users who need extra charting and chart-formatting power. Unlike its competitors, DeltaGraph covers both the PC and Mac platforms and now includes more charting choices, a slideshow facility, and a broad selection of analytical tools. DeltaPoint has extended the reach of DeltaGraph, however, at the cost of making the program difficult to learn and use.

The current version, a Win32s implementation that provides a single .EXE file for both 16-bit and 32-bit versions of Windows, adds 19 new chart types for a total of 63. These include 6 quality-control charts as well as histograms, ogive and pareto charts, box plots, open-high-low-close and candlestick charts, three types of vector charts, and pictographs (charts with graphical images as data markers).

DeltaGraph's strength remains presentation-worthy business graphs. Version 3.5 now supports OLE as a client, allowing it to forge automatic links with spreadsheet data. This is a boon for those who use frequently changing data for graphs. Unfortunately, however, direct import extends only to Version 4 of Microsoft Excel.

Other improvements to DeltaGraph include user-definable curve-fit formulas, a library of attractive layouts and backgrounds,

tated in 1-degree increments.

These improvements notwithstanding, DeltaGraph 3.5 does little to overcome its reputation as a tough nut to crack. Born on the Macintosh and ported to Windows two years ago, the program still looks like a fish out of water in the increasingly standardized Windows arena. PC users must contend with uncommon dialog boxes for printing and font selection, nonstandard dialog controls (drop-down lists out of plain text boxes, for example), the absence of eye-level toolbar legends, almost no support for the right mouse button, and a manual aimed primarily at Mac users.

Any package that takes charting this far will impose learning hurdles for users, but this one seems to go out of its way to boost the learning curve. If you need Macintosh file compatibility, DeltaGraph is worth the trouble. If you don't, Harvard ChartXL and Axum are more attractive candidates.

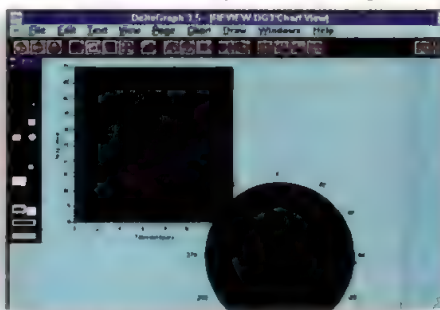
DeltaGraph Pro 3.5. List price: \$195. **Requires:** 4MB RAM, 7MB hard disk space, Microsoft Windows 3.1 or later. **DeltaPoint, Monterey, CA; 800-446-6955, 408-648-4000; fax, 408-648-4020.** Circle 411 on reader service card



page automatic document feeder. Each page enters at the top and exits in front of the scanner onto your table or desk. The scanner is Twain compliant, so you can scan pages directly into many popular Windows applications.

The WinFax PRO software is the full version of Delrina's standalone product, and includes the Fax Broadcast Service and the Cover Your Fax collection of more than 100 cover sheets. Xerox's TextBridge OCR software and Leadview's image editor are also included. A nice touch is a utility that turns your scanner and printer into a convenience copier.

Installation and setup were quick and easy; the WinFax Scanner plugs into your PC's parallel port. There is a pass-through

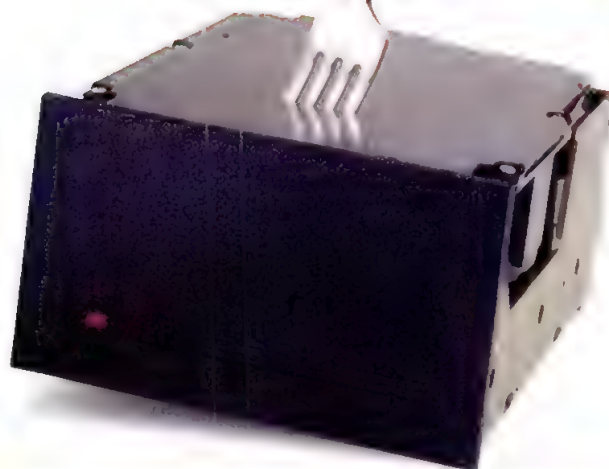


VISUALIZE NUMBERS: DeltaGraph offers a multitude of choices for charting spreadsheet data.

support for four-color models (CMY, CMYK, HSL, and RGB), Pantone ColorUP support, and improved options for fine-tuning the appearance of charts. Three-dimensional charts and axis labels, for example, can now be ro-

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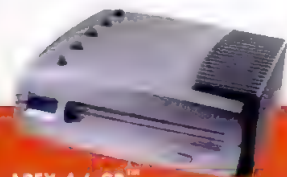
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CIRCLE 098 ON READER SERVICE CARD

AUDIO

AudioTriX Pro with SRS Makes Your PC Sound like a Theater

By Bruce Brown

If you've spent thousands of dollars on a home theater system, get ready to be humbled by reverse sticker shock. Stereo setups, game systems, and computers with inexpensive SRS 3D sound technology, using just two speakers, can rival or outdo the acoustic realism of Dolby Pro Logic or Lucas THX systems. MediaTriX Peripherals' AudioTriX Pro sound board—with the company's optional DSP/Effects daughterboard, which includes SRS sound—gives your computer

wavetable and FM synthesizer with 24-voice stereo wave output and 44.1 kHz sampling frequency, 2MB MIDI voice bank ROM, and OPL3- and OPL2-compatible FM synthesis. The Sound Blaster- and Ad Lib-compatible AudioTriX Pro has a Yamaha stereo 16-bit DAC, a Crystal CS4231 multimedia audio Codec, and a 4-watt-per-channel amplifier.

When the AudioTriX Pro is combined with the \$90 DSP/Effects board and the \$135 512K RAM board for multichannel

Wave-file editing, the system takes on a new personality. The dramatic difference in sound quality with the SRS 3D effect turned on will give you the impression that you are actually surrounded by sound. The

sound is not only richer, fuller, and more realistic, but it's nearly impossible to determine where the sound is coming from. With SRS turned off, the sound seems flat, and you can easily identify

that the source is the speakers.

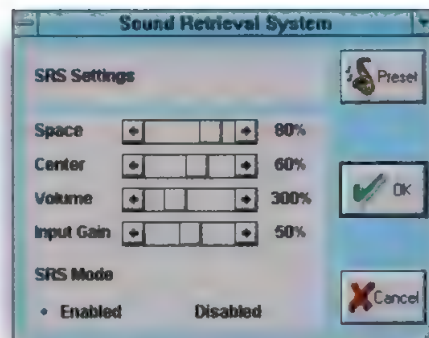
AUDIO HEAD CASE

The SRS (Sound Retrieval System) effect has been designed to interpret sound the same way the human ear does. The hardware/software system is modeled after the shape and acoustic dynamics of a portion of the outer ear called the pinna, which is responsible for picking up clues as to where sound is coming from.

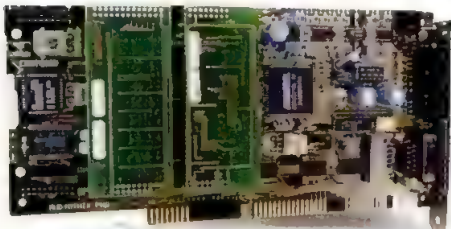
SRS works by using psychoacoustic phenomena called Head Related Transfer Functions (HRTFs), which provide the brain with position clues about the location of an audio source. The brain uses these clues to interpret sound entering our two ears as three-dimensional, real sound. SRS uses those same clues to create realistic three-dimensional sound from two speakers.

COMPATIBLE WITH...

The SRS system is compatible with Dolby Pro Logic and THX sound systems, but SRS is unlike those technologies because source recordings do not have to be specially engineered to achieve the end result. SRS works with stereo input and can also be used



LEFT, RIGHT, CENTER: AudioTriX's control panel can adjust the SRS 3D effect.



SURROUND SOUND: The AudioTriX Pro sound board adds SRS 3D for more realistic audio.

outstandingly realistic sound.

The specifications sheet of the \$295 base AudioTriX Pro board reads like a PC audiophile's wish list: Yamaha YMF278 (OPL4) stereo MPU-401-compatible

with monaural input sources. The drivers for the AudioTriX Pro board let you adjust the 3-D center and width of the 3-D sound to change the acoustic characteristics and positioning dramatically.

SRS 3D can work anywhere in the sound-production chain, and the company is licensing the technology to a variety of audio product vendors, including Sony and RCA for their high-end television sets, Nakamichi for audio components, Packard Bell for integration on computer motherboards, and, of course, audio card and speaker vendors.

While the focus is on cutting-edge audio hardware, the AudioTriX Pro comes with an excellent assortment of software, including MediaTriX DOS and Windows jukeboxes (to play .WAV and MIDI files), SuperJam Jr. Windows music-editing software, Sound Impression (a mixing panel and multimedia control center), Midisoft Music Magic MIDI sequencer and editor, Soft Karaoke (for MIDI karaoke files), a waveform editor, and a MOD graphics and sound file player.

Even without SRS technology, the bells and whistles on the AudioTriX Pro make the board attractive if you're serious about computer audio. With SRS 3D, however, the AudioTriX Pro takes a giant step forward in audio playback realism.

AudioTriX Pro. List price: With 512K RAM daughterboard and DSP/Effects board, \$520. Requires: Free 16-bit expansion slot. MediaTriX Peripherals Inc., Sherbrooke, Quebec, Canada; 800-820-8749, 819-829-8749; fax, 819-829-5100.

Circle 403 on reader service card

Vivid3D Speakers: Too Real for the Office

If you don't need a new sound card but want to improve your PC's voice, you can add SRS 3D sound by hooking up a pair of NuReality's Vivid3D Speakers. For an estimated street price of \$150, the Vivid3D amplified speakers can be used with computer sound boards, portable radios, cassette recorders, CD players, home stereo systems, game systems, and either monaural or stereo televisions.

The 9.4- by 4.8- by 8.6-inch (HWD) speakers weigh in at 9 pounds per pair and provide 10-watt-per-channel amplifiers. Each speaker box has four magnetized speaker drivers and connects to your audio source with included cabling via a stereo mini-jack. Speaker controls include power/volume, input source (SRS, bypass, or mono), center (which focuses on primary audio elements), and space (the overall audio width). The Vivid3D Speakers are available in either

black or standard computer gray cases.

When you switch the SRS enhancement on, the difference in sound fullness and realism is apparent. The increased spatial quality of the Vivid3D Speakers is enough that you may never want to go back to work again.—BB

Vivid3D Speakers. List price: \$199.95. Requires: Mini audio-out jack. NuReality, Santa Ana, CA; 800-501-8086, 714-442-1080; fax, 714-852-1059.

Circle 404 on reader service card



REAL SOUND: Vivid3D Speakers bring 3-D sound to any PC.

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Whether you choose pre-defined or custom formats, SureTrak's reports keep your team informed and on track. Bring raw numbers to life by displaying activity and resource information with bar charts, time-scaled networks, and resource graphs or tables. Customize your reports with text and pictures—even send and receive project updates through E-mail.

Analyze alternatives.

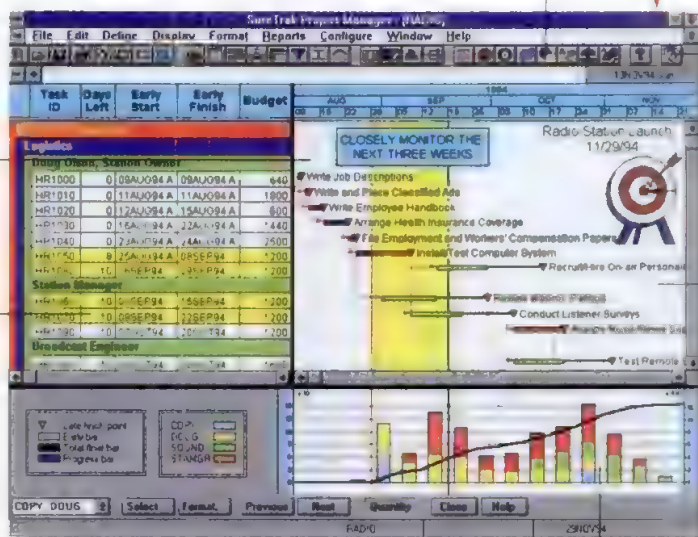
It's easy to compare different approaches to your project. With SureTrak's graphical interface, there's no limit to the ways you can organize and present activity information. Multiple activity codes let you drill-down, cross-cut and pivot your data so you can analyze the project from any perspective.

Take control now.

Unlike other project managers, SureTrak makes it easy to track who must do what, when, and how. Use Spotlight™ to focus on a graphical to-do list. Then use Spotlight again to update your progress and record what it takes to complete the project.

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An animated tutorial takes you on a quick tour of SureTrak's fundamental features—and the extensive help system is only a click away. SureTrak even reads Microsoft Project files, so you can take control immediately without losing any of your previous work.



Plan projects effectively.

Planning your projects with SureTrak is easy. Simply outline activities, estimate the time to complete each one, and link them together. Make scheduling changes on-screen as you go, and see them instantly reflected in your plan. It's called dynamic control and only Primavera has it.

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As the leading developer of project management software, Primavera has designed SureTrak to be an integral component of its Concentric Project Management™ software tool set—integrated, scalable tools for managing people, teams, and projects.

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The chart shows why long-time users of Microsoft Project are switching to SureTrak: it's better. But don't take our word for it. Try it yourself for 60 days. If you don't agree that SureTrak is the best project management software you've ever used, send it back for a full no-questions-asked refund.

The No Comparison Comparison		
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Intellisense™	✓	✓
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WINDOWS UTILITIES

Remove-IT: Too Much Saving and Too Little Removing?

By Edward Mendelson

In the crowded field of deinstallation utilities for Microsoft Windows, Vertisoft Systems' \$69.95 Remove-IT, Version 2.0, now weighs in with a range of features not found in rival packages but with weaknesses and design flaws of its own.

When used to remove existing programs and their related files, Remove-IT lags behind MicroHelp's UnInstaller 3 and Quarterdeck's Clean Sweep in the accuracy of its detection of files that ought to be removed, sometimes listing too few, sometimes listing far too many. But this is balanced by Remove-IT's elaborate backup and safety-net features and the clarity of its interface.

No deinstallation program is perfect, and Remove-IT's interface, which is similar in structure to Microsoft's software Wizards, encourages you to use maximum caution when removing files. New users can start with a cleanup

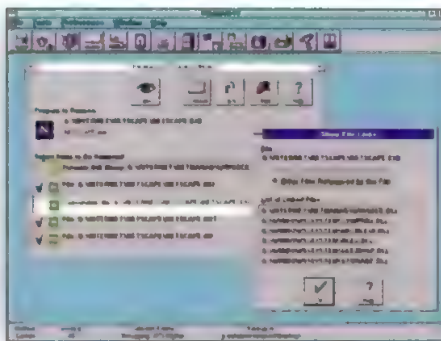
coach that guides you through the other modules, or you can start each module separately. By default, the program backs up in compressed form any files you remove.

Remove-IT's suggestions for file removal are often surprisingly aggressive. If you want to remove Adaptec's Easy-SCSI 32-bit disk-access software, Remove-IT tells you it's safe to delete not only this small component but the whole Easy-SCSI directory, along with the line in CONFIG.SYS that loads the basic SCSI driver. UnInstaller and Clean Sweep get this right.

Like UnInstaller 3, Remove-IT logs software installations, re-

moves duplicate and unneeded files, stores applications in compressed form if you use them only rarely, and bundles applications in a single file for easy transport to other computers. Remove-IT adds features that create an emergency boot disk and report on files that haven't been accessed for long periods, but it lacks UnInstaller's advanced features for editing .INI files and isn't as thorough in its search for unneeded files.

In deciding which files to re-



HITTING THE LINKS: Remove-IT displays the links referenced in executable files.

move, Remove-IT comes with a database that contains information on 850 applications. If a program isn't in the database, Remove-IT tends not to notice links

to .VEX files, such as those used by Ares Fontminder or Paul Bonner's EXEINFO utility. Fortunately, the program never lists these files as orphans that you can safely remove, but it leaves them behind when you store applications for transfer to other systems.

Remove-IT comes with a module to ease the upgrade to Windows 95 by letting you transfer all files from your Windows 3.1 directory to a new Windows 95 directory. A free upgrade to be shipped to users after Windows 95 arrives will help you be more selective by allowing you to transfer one application at a time.

Remove-IT Version 2. List price \$69.95. Requires: 4MB RAM, 3MB hard disk space, Microsoft Windows 3.1 or later. Vertisoft Systems Inc., San Francisco, CA; 800-466-5875, 415-956-5999; fax, 415-956-5355.

Circle 438 on reader service card

FAX SOFTWARE

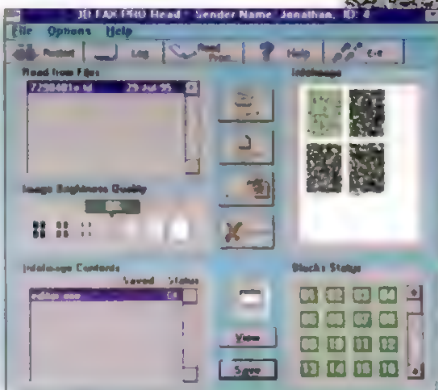
3D Fax Professional Teaches Old Fax Machines New Tricks

By Jonathan K. Matzkin

A new fax utility from InfoImaging Technologies can teach your fax card and standalone fax machine some pretty amazing new tricks. The \$199 3D Fax Professional allows file transfer via fax card, either to other fax-card-equipped PCs or to standalone fax machines. The software compresses and encodes any file as a pattern of black and white dots called an Infomage. Then 3D Fax Pro invokes your fax software and fires off the Infomage (see inset).

Sending Infomages saves transmission time. A complex, nine-page Microsoft Word document took a little over 17 minutes to transmit unencoded to a standalone fax at 9,600 bits per second (bps). The same file, compressed to a three-page Infomage, took less than 10 minutes to arrive at the same fax machine. And unlike the conventional fax, the Infomage arrived in editable form (once decoded) and with color attributes intact. A 180K .EXE file transmitted in about 32 minutes and ran fine when decoded.

If you send the file to a fax card, the receiving system uses 3D Fax Pro's read module to decode the file. Encoded files are unintelligible, even if printed out or viewed with graphics software. And for an extra level of protection, you can password protect the encoded Infomage. If the Infomage is received by a



FAX PROFESSOR: 3D Fax Professional gives your old fax machine new life.

standalone fax machine, you scan it into 3D Fax Pro's read module using any Twain-compatible scanner.

3D Fax Pro allows simple, convenient transfer of files via fax, which many users find less difficult than standard data-modem file transfers. A less-capable "standard" version is available; you can download a limited, free version at <http://www.infoimaging.com>.

3D Fax Professional. List price: \$199. Requires: 4MB RAM, 2MB

hard disk space (10MB recommended). Microsoft Windows 3.1 or later, fax modem, fax application software. InfoImaging Technologies Inc., Palo Alto, CA; 800-966-1140, 415-960-0100; fax, 415-960-0200.

Circle 437 on reader service card



From September 11 to 15, you can go on-line to discuss uninstaller programs with representatives from Vertisoft (Remove-IT), MicroHelp (UnInstaller), and Quarterdeck (Clean Sweep), and reviewers Edward Mendelson and Jerry Olsen. Type GO EXEC at any CompuServe! prompt.

CROSS-PLATFORM UTILITIES

Conversions Plus 3.0 Boosts Reliability and Graphics Support

By J.W. Olsen

With each release, DataViz's \$149 Conversions Plus lengthens its lead in the Mac-to-PC file-transfer and conversion market. This latest upgrade improves reliability, supports more applications, and introduces several new graphics features, as well as a preview mode. If you work regularly with both Mac and PC files, Conversions Plus 3.0 should be your best friend.

In Version 3.0, DataViz has improved its Mac-to-PC and PC-to-PC translation drivers. Test files that previously caused Conversions Plus to choke in midstream now translate flawlessly—as long as they are text-based files. When files with embedded graphics were translated to DOS rather than Microsoft Windows formats in our tests, the graphics were ignored. DataViz confirmed this weakness.

Many read-only formats now serve as destination formats as well as input formats. A few drivers—notably those for .GIF, TIFF, and JPEG graphics—are entirely new, while drivers for previously supported applications now recognize newer versions. Version 3.0 supports Microsoft Word 6.0 on both platforms and WordPerfect 6.1 on the PC.

A major improvement is the new Preview mode. Preview displays source files in seconds before you invest time converting and loading them into your application. While the displays can be rough, the ability to preview files is a time-saver nonetheless.

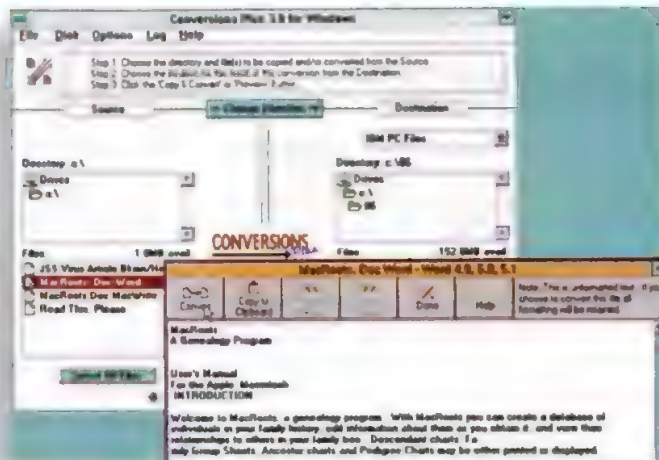
Two new graphics features also will be appreciated. From Preview mode you can translate only a selected rectangular area into your application, which speeds things up considerably (though output image boundaries don't always match the marked area). And if you're working with formats that Conversions Plus doesn't recognize, you can copy embedded graphics to the Win-

dows Clipboard and convert them from there.

Minor rough edges aside, Conversions Plus 3.0 is the clear leader of the pack.

Conversions Plus, Version 3.0. List price: \$149. Requires: 4MB RAM, 8MB hard disk space, Microsoft Windows 3.1 or later. DataViz Inc., Trumbull, CT; 203-268-0030, 800-733-0030; fax, 203-268-4345.

Circle 405 on reader service card



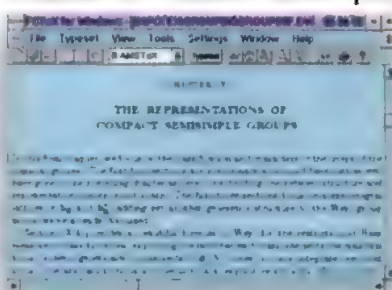
SNEAK PREVIEW: Conversions Plus provides a quick, down-and-dirty view of your source text, data, or graphics file.

SCIENTIFIC PUBLISHING

TeX Finally Comes to Windows

By Barry Simon

TeX, the text formatting system that is the established standard for producing complex scientific documents, is now available for Windows users.



BAR NONE: PCTeX's button-bar interface makes it easy to navigate the program.

Two programs—Kinch Computer's \$450 TrueTeX for Windows and Personal TeX's \$299 PCTeX for Windows—provide the TeX tools needed to prepare large documents laden with equations, charts, and graphs. While both programs provide three basic functions—compiling TeX binary .DVI files, previewing .DVI files, and printing completed files—they differ in terms of integration and interface.

Both TrueTeX and PCTeX for Windows are a mix of old and new. For example, they both include dozens of font files for Computer Modern Roman typeface in a variety of sizes. But neither has reconciled the digital font

base of TeX with the scalable font engines available in Windows. While TrueTeX provides 32-bit Windows programs for compiling, printing, and previewing your work, PCTeX has a Windows front end to provided DOS compilers and Windows-based print engine and previewer. Both programs support TeX and three popular variants, LaTeX, AMSTeX, and AMSLaTeX.

Of the two packages, PCTeX has the better interface. Within the program you can call the compiler, viewer, and printer. The dialog boxes have been designed so that if a project requires a .DVI file, it appears as the default when you call up the Print .DVI or View .DVI selections from the File menu.

Options are accessible via a well-designed toolbar. But PCTeX awkwardly relies on DOS boxes to run the compiler. And there are two versions of the compiler: a pure DOS version and one that uses a DOS extender.

By contrast, TrueTeX provides an integrated Windows approach—but with separate compiler, printer, and viewer programs. Overall, the inter-

face is not as elegant as PCTeX's. For example, if you shift between Plain TeX and LaTeX, the program forgets the directory in which you stored your TeX files. One nice feature is the viewer's ability to search .DVI files.

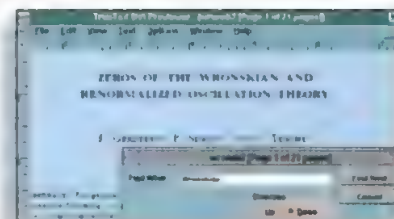
Both programs were speedy on our 486DX2/66 test-bed. PCTeX compiled a complex 50-page document in 22 seconds; True TeX took 26. When choosing between the two programs, the real question is whether you prefer TrueTeX's integrated approach or PCTeX's clearer interface.

PCTeX for Windows, Version 2.0. List price: \$299. Requires: 4MB RAM, 12MB hard disk space, Microsoft Windows 3.1 or later. Personal TeX Inc., Mill Valley, CA; 800-808-7906, 415-388-8853; fax, 415-388-8865.

Circle 406 on reader service card

TrueTeX for Windows, Version 4.0. List price: \$450. Requires: 8MB RAM, 4MB hard disk space, Microsoft Windows 3.1 or later. Kinch Computer Co., Pompano Beach, FL; 607-273-0222; fax, 607-273-0484; e-mail, kinch@holonet.net.

Circle 407 on reader service card



FIND IT: The TrueTeX viewer includes a powerful search dialog box.

VIDEO

ELSAmotion: Instant Windows MPEG Video

By Jan Ozer

By working through the PCI bus and the Display Control Interface (DCI), ELSA Inc.'s innovative \$299 ELSAmotion MPEG decoder avoids the performance and compatibility problems that plague MPEG adapters that rely on a graphics card's feature connector. While ideal for adding MPEG playback to PCs that are already equipped with DCI-enabled graphics, the ELSAmotion system lacks support for Sigma Design's DOS and Windows RealMagic specification, the most popular API.

The card uses IIT's audio and video MPEG decoder chip set to support Microsoft's OM1 Windows MCI-MPEG interface. The ELSAmotion system works by sending audio to the PC's sound card via a supplied external cable; it sends video to the PC's graphics

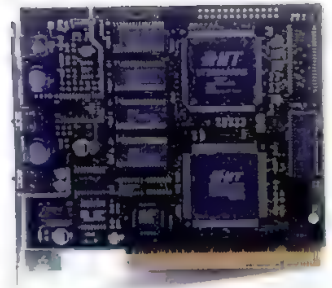
card over the PCI bus. This two-pronged approach effectively sidesteps the bandwidth limitations that usually prevent systems using a graphics card's feature connector from operating at color depths greater than 8 bits.

We tested the ELSAmotion system on a Gateway 60-MHz Pentium PC that was equipped with a Sound Blaster AWE32 sound card. In resolutions ranging from 640-by-480 to 1,024-by-768 and 8-bit, 16-bit, and 24-bit color depths, the ELSAmotion system flawlessly played MPEG files at full frame rate from a number of sources, including Ce Quadrat, Denon Digital, Future-Tel, Optivision, Sigma Designs, and Xing.

The system's MPEG playback complied with all tested Windows display protocols, neatly yielding MPEG display when switching to

other foreground applications—a feat never mastered by many feature connector boards. Using the Windows Media Player, the ELSAmotion system embedded successfully into several OLE client applications, demonstrating the stability of its MCI interface.

The ELSAmotion card proved compatible with several popular graphics cards, including the Diamond Viper Pro, the Matrox Millennium, the Number 9 9FX Motion 771, and ELSA's Winner 2000 ProX graphics card. The ELSAmotion system wasn't successful, however, with VideoCD/CD-i formats; it failed to play either of our test titles. This, combined with the lack of DOS or Windows RealMagic API support, makes ELSAmotion incompatible with many existing titles. While this is likely to change as title developers migrate to the



MPEG VIA PCI: The ELSAmotion video card uses the PCI bus for MPEG playback.

OM1 specification, it renders the ELSAmotion system unsuitable for those seeking immediate MPEG gratification.

Still, the ELSAmotion system sets a new standard for stability, ease of installation, and MPEG encoder compatibility.

ELSAmotion. List price: \$299. Requires: PCI-based system running Microsoft Windows 3.1, DCI-enabled graphics card. ELSA Inc., Santa Clara, CA; 800-272-3572, 408-565-9669; fax, 408-565-9650.

Circle 546 on reader service card

PROGRAMMING LANGUAGES

VisualAge C++ for OS/2 Catches Up to Windows

By Rich Dragan

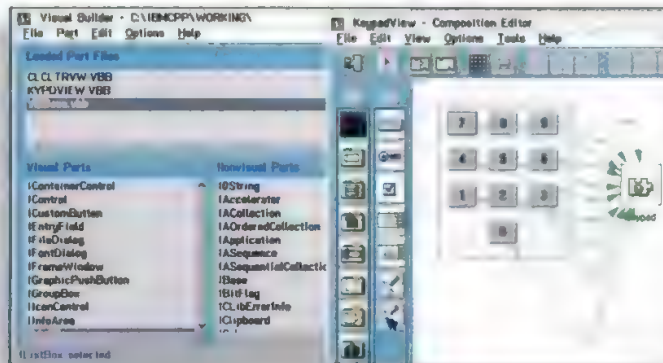
IBM's \$449 VisualAge C++ for OS/2 3.0 provides a necessary update for OS/2 programmers. Despite the fact that the upgrade has some heavy hardware requirements, the payoff is that the package features state-of-the-art component-based visual programming tools and a strong C/C++ compiler (including a formidable set of C++ class libraries), which together make it one of the most ambitious developer systems for OS/2 programmers.

VisualAge C++ for OS/2 builds on the IBM C Set ++ compiler and includes a strong library of C++ classes. The IBM Open Class Library includes support for a wide range of user interface and utility classes, including templated collection classes. Included in the compiler are excellent multimedia features, such as the direct playing of video and sound files; these features are not available to Windows programmers.

The VisualAge C++ integrated development environment

(IDE) relies on the IBM WorkFrame shell, which is an extensible workspace for your programming tools. As configured for

tures such as templates and exception handling, while the PM Debugger provides strong graphical debugging. You can view threads,



COMING OF AGE: VisualAge C++ for OS/2 uses IBM's WorkFrame shell as a workspace for programming tools.

VisualAge C++, the WorkFrame makes it easy to edit source files, build executables, browse classes, and access other tools from a single interface.

The Source Code Editor windows support syntax highlighting and macro capabilities. The compiler supports C++ language fea-

set watchpoints, view variables, and perform disassembly from within a single control window.

Visual Builder is a separate tool that adopts a component model of building applications using tried-and-true parts, or objects, that can be linked together or assembled using a visual pro-

gramming interface. The standard parts here are based on many of the IBM Open Class Library objects. The tool for designing new forms is the Composition Editor, which lets you connect objects by drawing lines, so programming is largely visual instead of script-based. You can call up part actions, manipulate part attributes, and respond to events (such as a mouse click).

On the downside, VisualAge C++ requires a whopping 193MB of hard disk space for a full installation, and you'll want at least 16MB of RAM to run either the C++ compiler or Visual Builder tools (or 24MB for both). Overall, VisualAge C++ for OS/2 3.0 is a powerful toolset for OS/2 development, combining an excellent class library, solid C++ compiler, and a cutting-edge parts-based approach to reusing software components.

VisualAge C++ for OS/2 3.0. List price: \$449. Requires: 12MB RAM (24MB recommended), 91MB hard disk space (193MB for full installation), OS/2 2.1 or later. IBM Corp., Armonk, NY; 800-426-3333.

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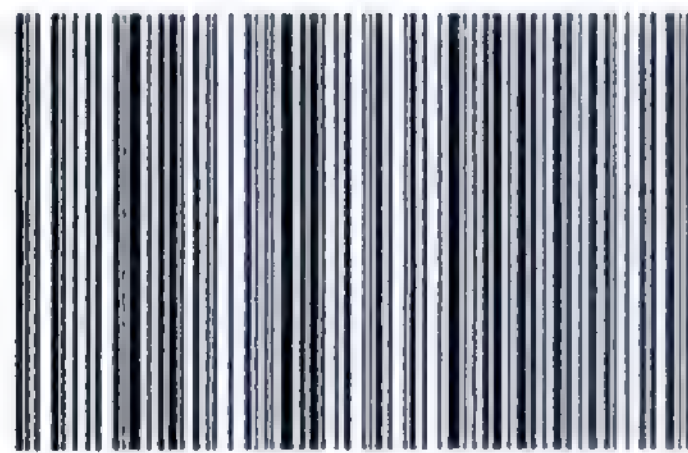
d Proclaims: r Is King!



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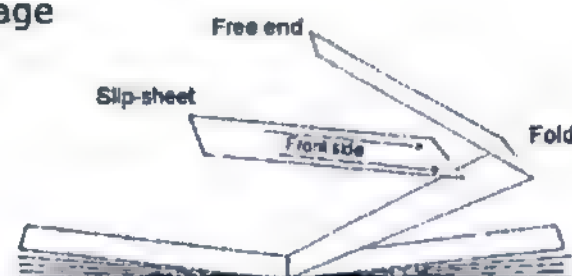


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3. Slice the folded edge
4. Close the page and slip-sheet



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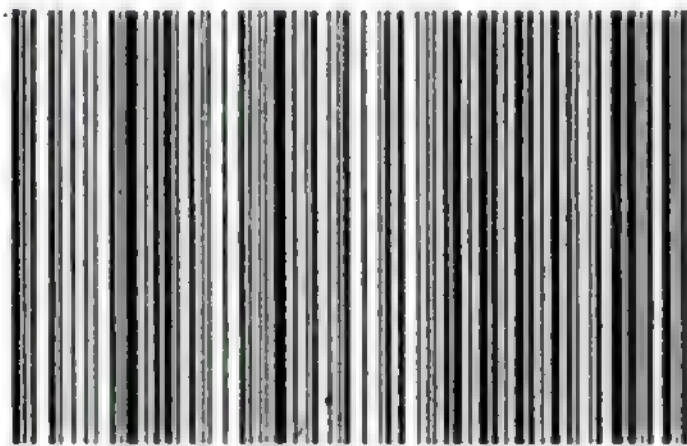
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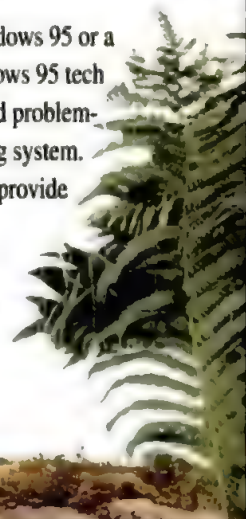
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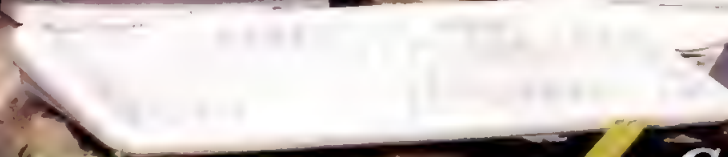
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WINDOWS UTILITIES

Hurricane Whirls Windows Performance to New Heights

By Neil J. Rubenking

Helix Software's \$79.95 Hurricane marshals a wide-ranging arsenal of utilities to speed Windows performance and increase effective system memory.

Hurricane's system monitor, WinGauge, displays detailed performance and system-resource information and flashes a warning when resources run low. And the analysis tool Discover for Windows lays bare more system information than the average user can hope to grasp.

Don't put off looking at Hurricane just because Microsoft Windows 95 is on the store shelves. Registered users of the Hurricane program will receive a free upgrade to the Windows 95 version when it becomes available.

TWEAK YOUR PEAK

No matter how much RAM your system has, you can still suffer from "out of memory" problems if you run out of free system resources (FSRs), conventional memory, or local descriptor table (LDT) entries. *Free system resources* refers to six specific 64K segments of memory owned by Windows but used by every application; they hold references to menus, menu items, drawing objects, and so on.

Conventional memory is DOS-accessible memory in the first megabyte; every Windows program absolutely requires a small amount of this memory. Finally, each block of memory managed by Windows uses one of 8,192 descriptors in the local descriptor table; if the LDT is full, Windows cannot allocate any more memory, period. Hurricane addresses the FSR and conventional memory bottlenecks; Helix Software is researching the possibility of breaking the LDT barrier as well.

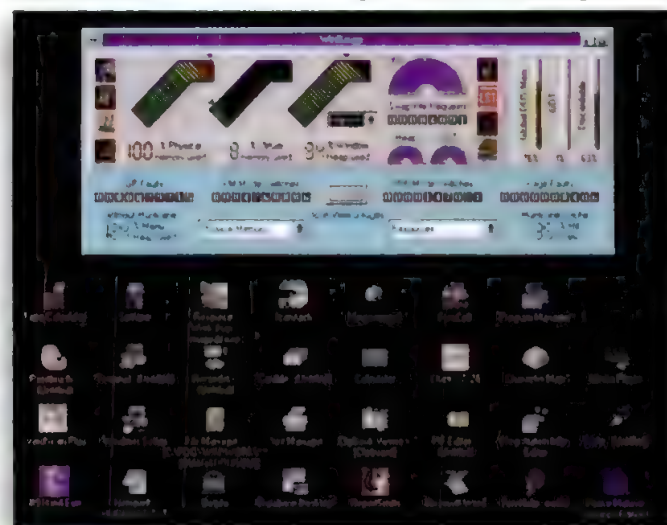
Hurricane's Heap Expander doesn't simply double the size of the FSR heaps. Rather, it tracks resource usage and, when necessary, frees up resources that are

not in use or swaps resources to local memory.

The Heap Expander has enabled us to load 32 Windows programs—many of them large—without running out of FSRs (we stopped at 32 because the LDT was full). The Heap Expander also cleans up after sloppy programs that terminate without freeing their resources.

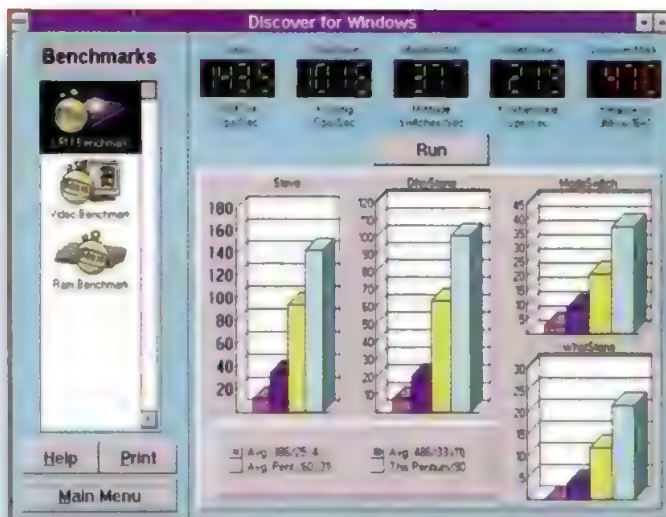
Windows has a bad habit of allocating conventional memory unnecessarily. Hurricane's Global DOS Memory Manager prevents Windows from misusing conventional memory in this way. It can also make unused upper memory blocks (memory above 640K and below 1MB) available as conventional memory.

Other Hurricane utilities tweak specific facets of Windows to provide more memory or further enhance performance. The Screen Accelerator speeds certain non-accelerated video boards, and the XMS Accelerator soups up expanded memory access for DOS-based drivers.



POWER-UP: Hurricane effectively increases the free system resources available to Windows, enough to run these 32 programs at once.

The Virtual Cache provides a dynamically resizable cache that works in concert with 32-bit file access in Windows 3.11 and with Hurricane's own Sector Cache.



INFO CENTER: Discover for Windows offers vast amounts of extremely detailed system information. Here it displays CPU benchmark test scores.

The Sector Cache provides read caching for drives not handled by 32-bit file access (for example, all drives on systems without 32-bit file access). Corruption of the essential Windows modules GDI, KERNEL, and USER is prevented by WinGuard, and the Mode Switch Accelerator uses features of Pentium and certain 80486 systems to speed CPU-mode switch events, which occur tens of thousands of times per second. Rounding out the

that one or more of Hurricane's modules will interfere with another of your applications or utilities. For example, the design environment in Borland's Delphi conflicts with the default configuration of the Heap Expander. The Hurricane Control Center allows you to set options for the individual utilities, turn them on or off, or uninstall Hurricane completely. On-line help is absent, however, so you're going to have to keep the manual handy.

A SYSTEM GUARDIAN ANGEL

Hurricane's WinGauge, seen in its fully expanded form, is the mother of all system monitors. WinGauge tracks the six FSR heaps individually, reporting on either a specified heap or the one that's fullest. It separately displays usage of fast physical memory (RAM) and slower, disk-based virtual memory. In its normal operating mode, WinGauge also displays representations of the LDT, the local heap, CPU activity, and swap-file requests.

Eight warning lights—four along each side of the window—light up to warn of problems. But their icons are confusing, and it can be difficult to tell when one is lit. Clicking on a light brings up a description of the problem and a suggested solution. Six lights indicate resource shortages (global DOS

First Looks

memory, total memory, physical memory, resources, unlocked memory, and LDT selectors). Another light signals inefficient settings in the Heap Expander, and the last advises of an application problem corrected by the Heap Expander.

When fully expanded, WinGauge displays still more information, most of it aimed at programmers, with the option to graph this data over the last 40 minutes. The most common reason to expand WinGauge fully will be to select two resources for display on WinGauge's minimized icon. Like the Control Center, WinGauge offers no on-line help.

DISCOVER YOUR SYSTEM

Hurricane's third major module, Discover for Windows, spews forth an absolutely staggering amount of information about system hardware and software. Five modules scrutinize software, memory, system hardware, disk drives, and I/O devices, and a sixth module provides performance indicators for CPU, video, and RAM.

You can find out precisely how much conventional memory a particular program uses or check which devices use the PCI bus, for example. Discover lists the size and count for each individual object type in the FSR heaps.

The average user will probably consult Discover to answer technical-support questions or to print a detailed system description for reference. Programmers will have a field day listing entry points for unknown DLLs (dynamic link libraries) or extracting resources (icons, bitmaps, and even dialog boxes) from any application. These examples don't even begin to scratch the surface of the arcane facts available from Discover.

Helix's Hurricane program installs easily and attacks the problem of making your Windows system faster and more powerful from many directions at once. This multilateral approach means Hurricane should enhance any Windows system.

If your system is too slow (and whose isn't?), Hurricane will tweak Windows' peak performance to a higher level without resorting to any hardware upgrades. Hurricane does many use-

ful things that should have been part of Windows in the first place. It is essential equipment for today's Windows PC.

Hurricane. List price: \$79.95. Requires: 4MB RAM, 2MB hard disk space, Microsoft Windows 3.1 or later. Helix Software, Long Island City, NY; 800-451-0551, 718-392-3100; fax, 718-392-4212.

Circle 415 on reader service card

WINDOWS UTILITIES

MagnaRAM Compresses Windows Memory—But Do You Want It To?

By Edward Mendelson

As Microsoft Windows 3.x approaches the end of its useful life, a variety of new memory-enhancement products have suddenly begun to resuscitate it. Connectix's RAM Doubler (reviewed in First Looks, July 1995) increases the size of the 64K heaps where Windows keeps its screen resources. Helix Software's Hurri-



WARNING LIGHTS: WinGauge displays resource information; the third light on the left is lit, warning that slower virtual memory will soon be in use.

going through the inherently slower process of reading them from the swap file on-disk. MagnaRAM installs itself in the form of a dynamic link library (DLL) and a virtual device driver (VxD), both referenced in SYSTEM.INI. MagnaRAM does not increase the memory available to Windows—that's a job for a memory manager such as QEMM—but

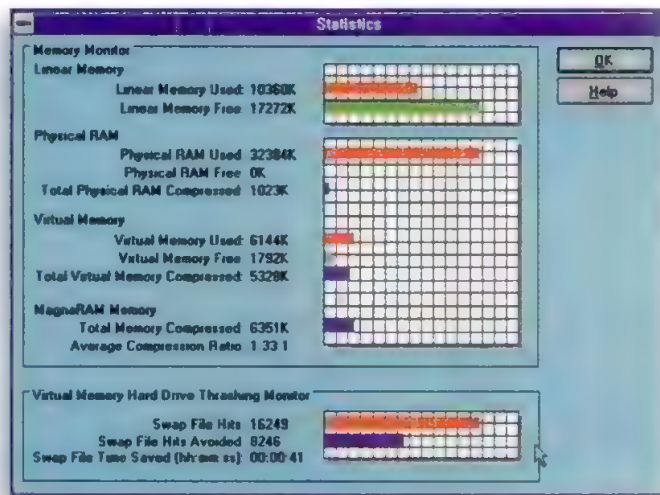
figured system with 3MB of extended memory available to Windows, MagnaRAM compressed memory pages but slowed real-world performance. Without MagnaRAM, the system loaded Microsoft Word for Windows in 17 seconds and Microsoft Excel in 18 seconds. With MagnaRAM installed, and with MagnaRAM given enough time to compress memory before we started our tests, Word needed 22 seconds to load and Excel needed 25 seconds.

Also, although the manual points out that MagnaRAM should let you open more DOS sessions than you could without, it probably won't let you run many more Windows applications than you do now. In the same test system, we were able to open Micrografx Picture Publisher, Microsoft Excel, Microsoft Word, WordPerfect, and QuarkXPress, both with and without MagnaRAM installed. Windows then hit the wall by running out of free system resources, and MagnaRAM doesn't do anything to help. In the same setup, with RAM Doubler installed instead of MagnaRAM, Windows reported less free RAM, but the additional resources let us load OmniPage Pro and Visio in addition to the other five applications.

You can run only one Windows memory enhancer at a time, and RAM Doubler will generally produce greater benefits than MagnaRAM. But Hurricane may take most users by storm.

MagnaRAM for Windows. List price: \$129. Requires: 4MB RAM, 2MB hard disk space, Microsoft Windows 3.1 or later. Landmark Research, Clearwater, FL; 800-683-6696, 813-443-1331; fax, 813-443-6603.

Circle 416 on reader service card



COMPRESSED: MagnaRAM's statistics screen shows the program's memory compression while it occurs.

cane (see the adjoining review) has a whole suite of memory and speed enhancements. And Landmark Research's \$129 MagnaRAM for Windows increases the memory available to Windows apps.

Of these three products, MagnaRAM probably has the most specialized and limited appeal. It temporarily compresses "pages" of memory so that Windows can find those pages in RAM when needed, instead of

compresses only the RAM that would be available anyway. A statistics screen shows this compression taking place when Windows isn't performing other functions. Landmark suggests that the program will be most useful in systems with 4MB or 8MB of RAM, and that in those systems it should increase speed by reducing the number of times Windows has to read data from the swap file.

In practice, on a minimally con-



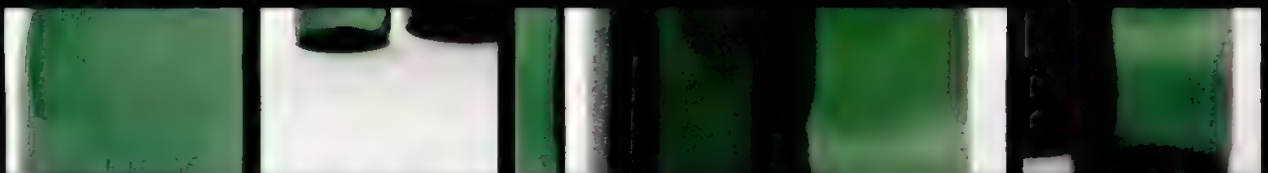
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PERSONAL FINANCE

Quicken Financial Planner: Baby-Boomer Investment Tool

By Theresa W. Carey

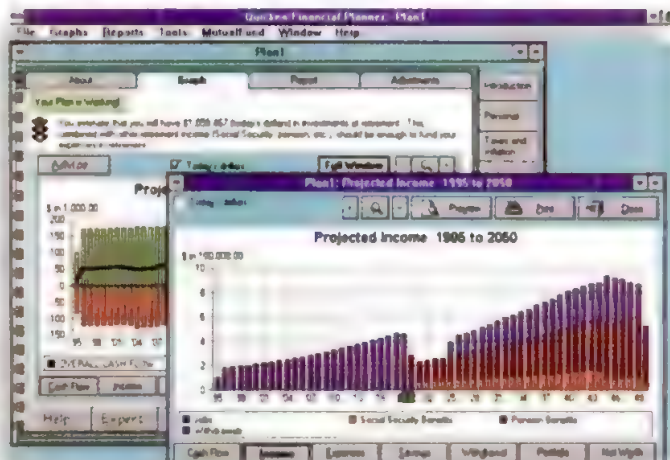
Retirement planning software is the new impulse buy for aging baby boomers. Those of us due to retire in the next 15 to 25 years have been doing a terrible job of saving for the future, but Intuit's \$39.95 Quicken Financial Planner (QFP) CD-ROM can help us start pumping more money into our retirement accounts.

QFP—which uses a notebook metaphor for entering data and presenting results—features advice from Jane Bryant Quinn on various topics such as planning for inflation and the odds that Social Security will exist 20 years down the road. The program easily imports data from Quicken for Windows (Version 4 only); alternatively, you can enter your personal data manually. You tell the program the value of all your current investment assets, your home, and your outstanding loans. You also enter your current earnings and expenses, allowing for changes after retirement. The earnings data-entry screen is aimed at employees, showing a curious disregard for the self-employed.

Finally, you enter your current savings habits and QFP assesses how close you are to your retirement target. The program will advise you on which areas you should focus on for retirement investing, and includes the Morningstar Mutual Fund database. Quarterly Morningstar updates are available for \$39.95 per year.

There are a few rough edges in an otherwise nicely designed program. Savings plans are mostly defined as percentages of earnings, and in some places it's impossible to enter a fixed dollar figure. And while the program asks you about the purchase price and current value of your residence, it provides no way for you to enter improvements made. QFP is a bit behind the times, too: The initial entry screens assume that the person generating the plan is male with a female spouse.

The CD-ROM version features quite a bit of video of Jane Bryant Quinn dispensing advice;



GETTING READY FOR THE FUTURE: Quicken Financial Planner displays graphically the results of your retirement scenario.

CONTACT MANAGERS

WinSales 3.0 Takes Advantage of Networks

By Kevin Reichard

WinSales 3.0 is an impressive upgrade of an already praiseworthy contact-management package that is now as adept at organizing a group over a network as an individual user. WinSales gives the system administrator the power to script every part of the sales process, from initial contact to final purchase. The \$249 program backs this up with an impressive suite of administration tools that includes a programming language and full networking support.

Earlier versions of WinSales were little more than individual copies that accessed a common database on the network. In Version 3.0, the network takes on a central role. The advanced control given to system administrators puts WinSales in direct competition with Elan Software's GoldMine and Tracker Software's Tracker for Windows.

WinSales lets users view the calendars of others on the network and arrange group meeting times. The program compares user calendars to find an open slot. If WinSales is set up on a MAPI-compliant network, notification of a meeting is sent via e-mail.

Version 3.0 adds Action Plans, which allow the automation of certain tasks when a record is accessed. In addition, Triggers can start event-driven scripts that

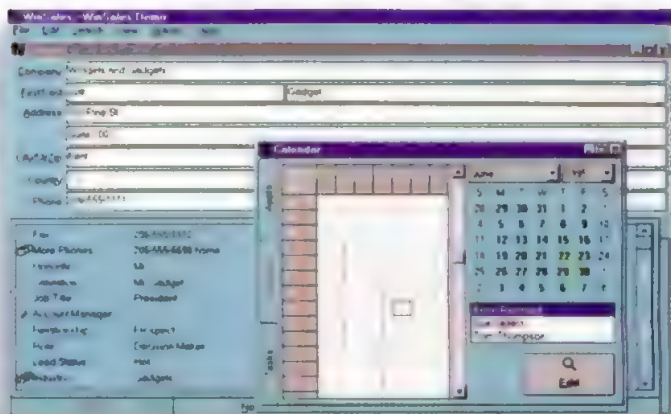
she's accessible by clicking on the Expert button. QFP's screen layout is pleasant and relatively uncluttered, and the program is well organized. Still, it lacks the extra perspective that Marshall Loeb's comments lend to the multimedia version of Quicken.

QFP's main competition is DataTech's Rich and Retired, which offers a few more tools but isn't as easy to use. If you're without a retirement plan in place, it'll be worth your while to spend a couple of hours with Quicken Financial Planner.

Quicken Financial Planner. Estimated street price: \$39.95. Requires: 8MB RAM, 16MB hard disk space, Microsoft Windows 3.1 or later, CD-ROM drive, sound board and speakers. Quicken Investment Services Inc., Menlo Park, CA; 800-816-8025. Circle 401 on reader service card

tion explaining the basic steps would have been welcomed.

WinSales 3.0's advanced scheduling capabilities and network integration make it a seri-



GROUP SALES: WinSales lets you view your coworkers' calendars in order to arrange group meeting times.

ous choice for those looking for a networked contact manager. WinSales 3.0. List price: \$249; Professional Edition, \$495; 5-user network version, \$1,495. Requires: 4MB RAM, 7MB hard disk space, Microsoft Windows 3.1 or later. WinSales Inc., Bellevue, WA; 800-206-747-2464; fax, 206-747-2955.

While straightforward, this use of contingencies involves programming with Visual Basic. The manual assumes some familiarity with programming; documenta-

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STATISTICA

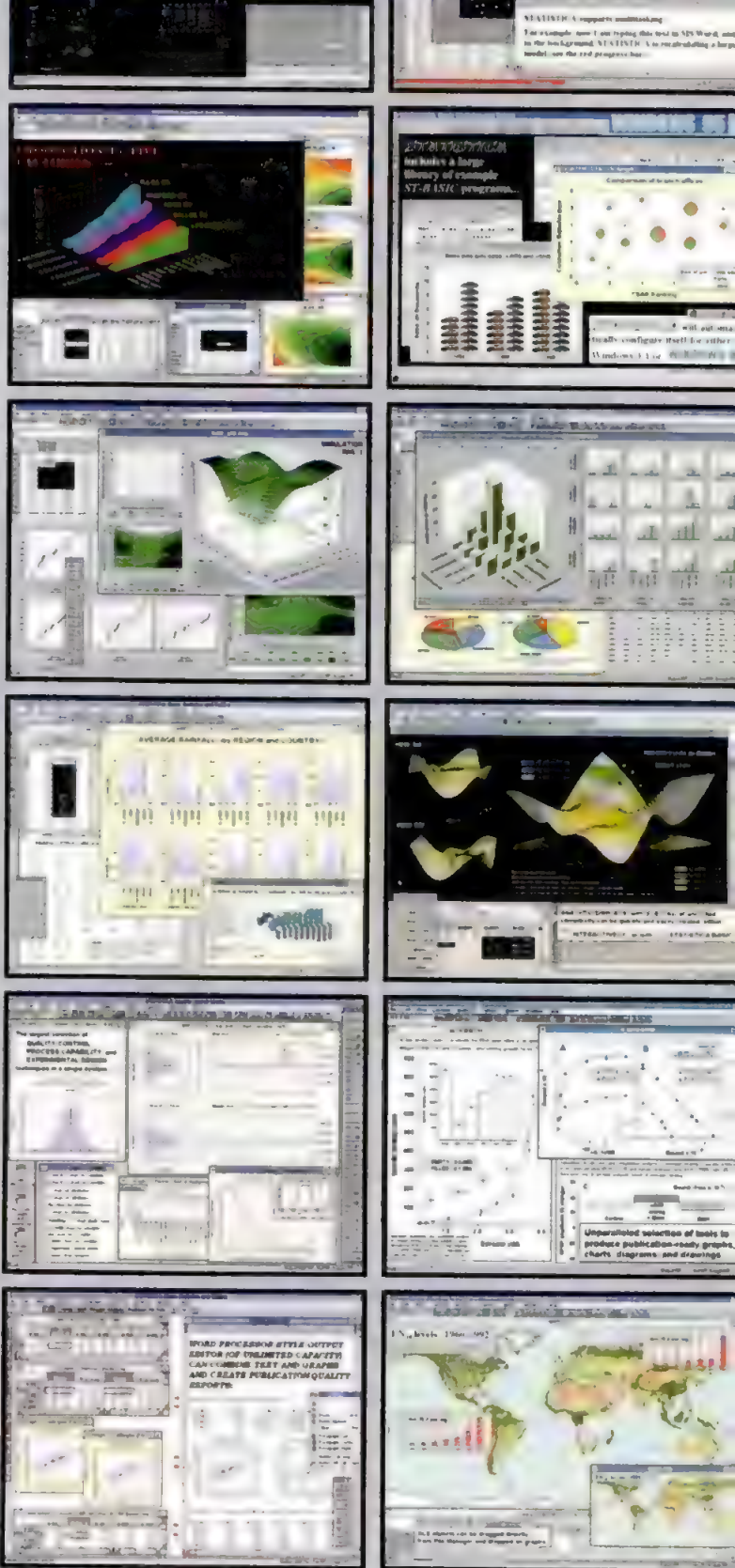
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INTERNET ACCESS

Navigator Personal Edition: The Quickest Way to the Internet

By Melissa J. Perenson

The \$39 Netscape Navigator Personal Edition is an Internet solution tailored for those who prefer not to get their hands dirty configuring TCP/IP stacks, Winsocks, and other arcane configuration files. Navigator Personal Edition combines Netscape's powerful Navigator 1.1N browser (First Looks, July 1995) with what is arguably the quickest and most complete setup program around.

The key feature is Navigator Personal Edition's registration Wizard, which guided us through the sign-up process and even established a new account with a service provider.

The program dials an 800 number to reach Netscape's registration server. The server, which sometimes runs slowly, offers detailed information about the pricing and services of Netcom, internetMCI, and Portal—the three service providers available with Navigator Personal Edition's first release. To access the Web, just click on Netscape Navigator and a pop-up dialer calls your service provider.

If you already have a PPP Inter-

net service provider, this package can accommodate you, although the custom installation is cumbersome. One other problem hounds Navigator Personal Edition: Its list of supported modems, while adequate, is not deep. The system misidentified the WinBook XP's internal modem during tests.

Minor problems aside, Personal Edition is today's shortest route to the Web.

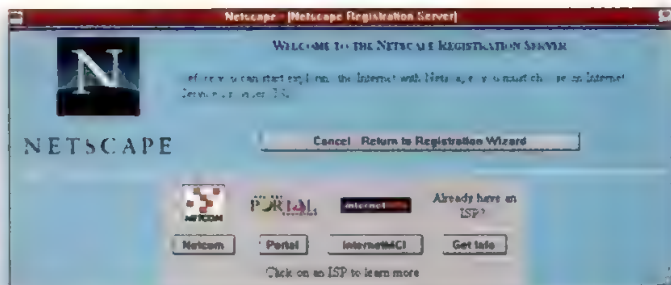
UTILITIES

StarBase's Boris Keeps an Eye on Your PC

By David Haskin

StarBase's Boris 1.0 is a handy utility for automating system maintenance and archiving. At \$39, it is an inexpensive way to eliminate unneeded files, back up files, monitor available disk space, and maintain multiple versions of documents.

Boris works by creating Assistants, which perform tasks in the background. For example, we created an Assistant to periodically find and delete old .TMP files. After scanning the hard disk,



QUICK START: Netscape Navigator Personal Edition provides near-instant access to the Internet's World-Wide Web.

Netscape Navigator Personal Edition. Estimated street price: \$39. Requires: 4MB RAM (8MB recommended), 1MB hard disk space, Microsoft Windows 3.1 or later.

Netscape Communications Corp., Mountain View, CA; 800-528-6292, 415-528-2555; <http://www.netscape.com>.

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TRAVEL

Where to Stay? Consult OAG HotelDisk

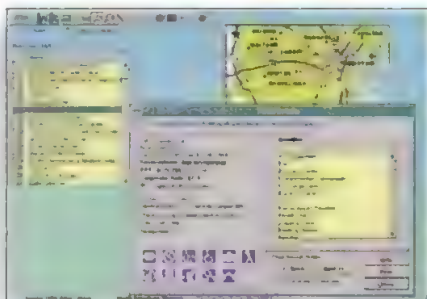
By Barry Simon

OAG's HotelDisk, at \$247 for four quarterly updates, can be the frequent traveler's PC-based travel agent. It's a hotel locator with listings for roughly 30,000 hotels in North America and maps for 128 cities in 90 metropolitan areas (a \$147 version covering 30 large metropolitan areas is also available).

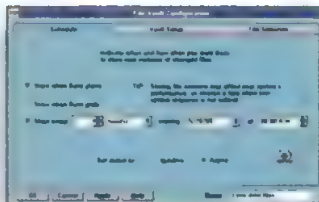
You can search for a hotel based on a variety of criteria, from how far it is from selected points of interest to whether it has an on-site health club. Once you find a suitable

hotel, the program displays a list of amenities, as well as credit-card information, price ranges, and toll-free numbers for reservations.

Most of the 30,000 hotels can be located on the maps that are included. While these maps are



WHERE TO GO: HotelDisk provides lists of hotels located on a city map.



INSTANT ASSISTANT: Boris creates Assistants with simple dialog boxes.

Boris displayed a list of deletion candidates.

In addition, Boris can launch programs and batch files auto-

not as detailed as those provided with DeLorme's StreetDisk, they do show the major streets. The program performs searches quickly, although in one instance, HotelDisk had the correct address for a motel but the wrong map placement.

For now, HotelDisk is independent of the OAG's companion product, FlightDisk, but the company is looking to link the two programs in the future, producing an all-in-one travel companion.

HotelDisk, Version 1.0. List price: With four quarterly updates for North America, \$247; with four quarterly updates for 20 metropolitan areas, \$147. Requires: 4MB RAM, 18MB hard disk space, Microsoft Windows 3.1 or later. Official Airline Guides, Oak Brook, IL; 800-323-3537; fax, 708-574-6667.

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matically, and warn you when available disk space falls below a specified level. Its File Vault feature can archive newer versions of selected files to a compressed Vault on local or network drives. Boris archives the file when you open a new version, and can save up to 25 different versions. We configured Boris to scan for new and modified files every two hours and place those files in a Vault.

Managing archived files can be clumsy, however. You can only give long descriptive names to permanent versions and Boris has no built-in file viewers. Rather, when you click the View button, Boris loads the file with its application. While the application seems to operate normally, Boris prevents it from permanently saving changed files. This makes it easy to modify file contents and mistakenly believe you are saving the changes. StarBase plans to fix this bug soon.

If you can accept these limitations, you'll find Boris to be an excellent tool for automating basic maintenance tasks and simplifying version control. It's also an industrial-strength method for backing up files.

Boris 1.0. List price: \$39. Requires: 4MB RAM, 3MB hard disk space, Microsoft Windows 3.1 or later. StarBase Corp., Irvine, CA; 714-442-4400; fax, 714-253-6712.

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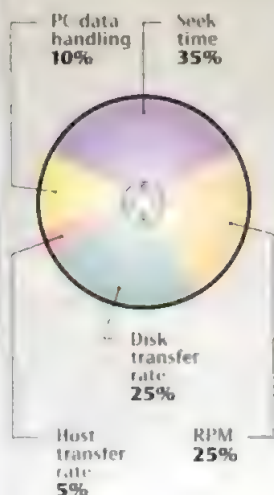
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In addition, HP ranked best overall among desktop PC business users in the 1994 J.D. Power and Associates Customer Satisfaction Study.¹

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That's because each is from ADI—a world leader that's put over four million OEM monitors on the market in the last two years. Which means, for a great price, you get the quality and performance of a much more expensive monitor. Plus you get reliability. For proof, just look to our ISO-9001 rating. And our own manufacturing process that allows complete control over quality. Which is why we can offer a two-year warranty.

So phone us today. See why you can't afford to let these great models pass you by. For more information on ADI, our monitors and the ADI Authorized Reseller/Demo Program, call 1-800-228-0530. For automated faxed product information and editorial reviews, call 1-800-767-8182

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	MICROSCAN 3V	MICROSCAN 4V
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New & Improved

NEWS OF ANNOUNCED PRODUCTS AND UPGRADES

By Melissa J. Perenson

Canon Comes Home with Three Color Printers

Canon Computer Systems is targeting its new trio of entry-level ink jet color printers at the home and small-office markets, bundling a CD-ROM of low-end graphics applications for creating greeting cards, labels, stationery, and sewing patterns.



BRIGHT STAR: The Canon BJC-610 offers 720-dpi images in color and monochrome.

The top-of-the-line BJC-610 produces 720- by 720-dot-per-inch monochrome and color images in bright, fade-resistant inks. This \$599, 10-pound model measures 7.2 by 16.1 by 10 inches (HWD) and produces from 0.7 to 1.3 color pages per minute. An automatic sheet feeder handles 100 sheets of letter-, legal-, or A4-size paper, or 15 envelopes. The printer is equipped with the Microsoft Windows Printing System. Canon also offers the \$399 720- by 360-dpi BJC-4100 and the \$299 360- by 360-dpi BJC-210. All three new printers come with the Canon Creative CD-ROM, which includes 300 TrueType fonts.

Canon BJC-610. List price: \$599. **Canon BJC-4100.** List price: \$399. **Canon BJC-210.** List price: \$299. Canon Computer Systems Inc., Costa Mesa, CA; 800-848-4123, 714-438-3000.

Circle 419 on reader service card

Filing as Simple as ABC

Half the hassle of downloading and storing files is finding a way to manage the menagerie you end up with. **FileABC**, maker of FileABC 5.0, provides a standalone solution by storing documents as graphical images in its own database.

Files are captured in FileABC's proprietary format in one of three ways: via a Twain-compliant scanning device, from a fax modem board, or by printing a document to FileABC using the provided print driver. FileABC is compatible with .DCX, .PCX, and TIFF files, and documents



Portable Value Power

NEC Technologies Inc. and **AT&T Global Information Solutions** are both offering notebooks that pack a strong punch for less than \$2,000 each.

NEC is targeting the small-business market with its Versa 2000 series of notebooks. The 6.3-pound NEC Versa 2000D, which starts at \$1,999, is a basic system that includes a 10.4-inch dual-scan passive color display, a DX4/75 CPU, 4MB RAM, and a 350MB hard disk. The \$2,599 NEC Versa 2000C, which weighs 6.5 pounds, has a 9.5-inch active-matrix color display, 8MB RAM, and a 350MB hard disk (a 540MB hard disk is available as a \$200 option). Each of these units has NEC's VersaGlide touch pad embedded in the wrist rest, and a lithium-ion battery. There is one Type II PC Card slot and one Type III slot.

The Globalyst 130, from AT&T Global Information Solutions, has a 10.4-inch dual-scan passive color display, a DX4/75 CPU, 4MB RAM, a 340MB hard disk, and a Type III PC Card slot. Designed with convenience in mind, the Globalyst 130 weighs about 5 pounds with the nickel hydride battery installed. A centrally located trackball is built into the wrist rest. AT&T includes Vistium Share (document-sharing software), which lets mobile users collaborate on documents in real time over a modem or network connection.

NEC Versa 2000D. List price: \$1,999. **NEC Versa 2000C.** List price: With 350MB hard disk, \$2,599. NEC Technologies Inc., Boxborough, MA; 800-632-8377, 508-264-8000.

Circle 417 on reader service card

Globalyst 130. List price: \$1,999. AT&T Global Information Solutions, Dayton, OH; 800-447-1124, 513-445-5000.

Circle 418 on reader service card

may be retrieved, indexed, viewed, printed, annotated, exported, or faxed.

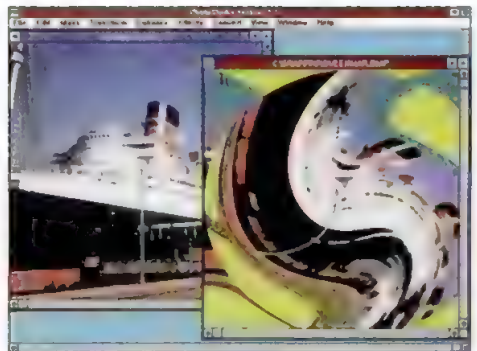
FileABC, Release 5.0. List price: \$99.95. FileABC (A Nevada Limited Partnership), Honolulu, HI; 800-366-4464, 808-523-7857; fax, 602-942-5199.

Circle 431 on reader service card

Image Editing Made Easy

With its easy-to-use interface and flexible features, **ArcSoft's** \$90 ArcSoft PhotoStudio 1.5 for Windows has something for everyone. PhotoStudio offers much of the versatility of higher-end image-editing packages at a lower price.

Everything you could want and more is packed into this Twain-compliant software. PhotoStudio's sleek design makes it as easy to use as such basic image editors as Storm Technologies' Easy Photo, and its robust and advanced selection of image controls rivals programs such as Ulead's ImagePals 2. You can liven your image with such amusing special effects as ripple, splash, fish-eye perspective, motion blur, oil painting, ribbon, or emboss. Enhancements can be previewed with the program's thumbnail viewer.



SPIRALS: PhotoStudio adds eye-catching effects.

ArcSoft PhotoStudio 1.5 for Windows. Estimated street price: \$90. ArcSoft Inc., Milpitas, CA; 800-762-8657, 408-262-8657; fax, 408-262-8941. Circle 421 on reader service card

ZAP-it Moves Messages Through the Air with Ease

Call it the mobile professional's personal e-mail service—and then some. **DTS Wireless's** ZAP-it is a two-way wireless messaging service that lets you send and receive e-mail or faxes, send messages to alphanumeric pagers, and even have the system's text-to-voice engine read e-mail to you when you're away from your computer. All you

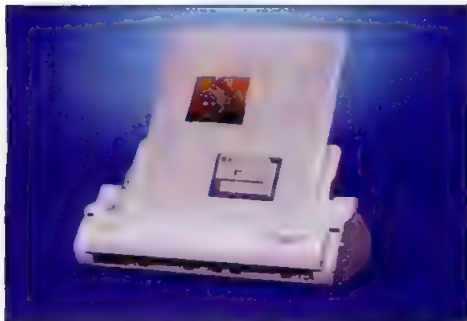
New & Improved

need is a laptop or HP LX-series palmtop computer, ZAP-it software, and a compatible wireless modem, such as the IBM PC Card Wireless Modem for Mobitex or the serial-port Motorola InfoTAC modem. ZAP-it, which uses RAM Mobile Data's nationwide wireless network to send messages, costs \$9.95 per month (not including per-message charges that range from 39 to 99 cents) and has a one-time activation fee of \$34.95. **ZAP-it.** List price: \$9.95 per month, \$34.95 activation fee. DTS Wireless, Woodbridge, NJ; 800-967-0943; e-mail, info@dts.net.

Circle 422 on reader service card

PageWiz Whizzes Along

Joining the recent flood of page-fed scanners that have hit the market is **Microtek Lab's** PageWiz. Competitively priced at \$200, PageWiz is integrated with Microtek's drag-and-drop PageSuite software, which adds fax, e-mail, copying, and filing functionality, and is bundled with Caere's optical character recognition (OCR) software OmniPage LE. The unit can produce a 4-bit gray-scale scan in a single 28-second pass, or a 1-bit black-and-white scan in 12 seconds. Documents are scanned at a resolution of up to 300 dpi. Compactly designed to fit on just about any desk, this 2.4-pound Twain-compliant unit can easily be tucked under your arm and taken on the road. The parallel-port interface includes a print-pass-through connection.



SHEET FEEDER: Microtek PageWiz makes it easy to scan sheets of paper into your PC.

Microtek PageWiz. Estimated street price: \$200. Microtek Lab Inc., Redondo Beach, CA; 800-654-4160, 310-297-5000; fax, 310-297-5050.

Circle 424 on reader service card

Keep Track of Your Files

Not just for pros, **Digital Instrumentation Technology's** \$169 TransferPro for Windows lets you read and write files between your PC and a host of standard data-storage media with ease, including Syquest and Bernoulli drives and Macintosh disks and CD-ROMs. The Macintosh support has been improved with this upgrade, so that now disk formatting is based on drive capacity rather

HARDWARE BRIEFS

MicroSolutions' backpack 800T Travan tape drive lets you have the best of all tape worlds. This \$379 parallel-port unit uses either Gigatek EC, QIC-80, QIC-Wide, or Travan TR-1 tape cartridges. If you use the Travan tapes with the included data compression software, the maximum storage capacity is 800MB; the maximum capacity without compression is 390MB. 800-890-7227.

Multimedia upgrade kits get a quad-speed boost with **Diamond Multimedia's** Diamond Power Kit 7000. For an estimated street price of \$399, you get an IDE quad-speed CD-ROM, a 16-bit, 1MB Wavetable Diamond sound card (Sound Blaster-compatible), 15 watt-per-channel amplified speakers, a joystick, and a microphone. The kit includes 22 quality game, reference, and edutainment titles for hours of entertainment, including Compton's Interactive Encyclopedia, Dark Forces, DOOM, and Myst. 800-468-5846.

ActionTec's ComNet 28.8 (V.34) Fax Modem + Ethernet Combination Card offers the convenience of two products in one \$599 unit. Now you can simultaneously make modem and Ethernet connections from a single PC Card slot, so that you can be on-line while still attached to the network. This V.34-compliant PC Card pairs a 28.8-Kbps fax modem with a 10Base-T Ethernet connection. The modem features V.42 advanced error correction, 14.4 Group III fax auto send and receive, and a power management mode. 800-797-7001, 408-739-7000.

Now you can connect a modem directly to a cellular phone without using an interference device. **Megahertz Corp.** goes cellular with the addition of cellular direct-connect capabilities to its Megahertz 14.4-Kbps PCMCIA fax modem with X-Jack and the cable connector version; both are priced at \$249. Motorola and Nokia cellular phones will be supported, and the \$79 connector cables link the modem to your cellular phone. 800-527-8677, 801-320-7777.

Tired of squinting at your old 14- or 15-inch monitor? **ViewSonic** is offering an affordably priced 17-inch monitor. The \$795 Optquest 1769DC, a value-line monitor, supports resolutions up to 1,280-by-1,024 and is Plug and Play-compatible for use with Windows 95. ViewSonic's Opti-Green power management software is available at no extra charge. 800-843-7684, 909-468-3750.

than vendor ID; also, 4GB Macintosh partitions are now supported—a particular boon for graphics professionals. A dBASE database automatically tracks the contents of all media logged in to help you locate any file and the disk it resides on. **TransferPro for Windows.** List price: \$169. Digital Instrumentation Technology Inc., Los Alamos, NM; 800-467-1459, 505-662-1459; e-mail, tpro-request@dit.com.

Circle 420 on reader service card

Crossing the Great Wall

Between China's nascent economy and the exploding demand in that country for computers and technology, there's a growing need for professionals who speak the language. **VentureTech's** Professional Interactive Chinese for Windows, Version 2.0, is the first interactive language-lab approach to learning Mandarin Chinese. What this \$295 CD-ROM lacks in snappy visuals it more than makes up for in the strength and orga-



LEARN THE LANGUAGE: With *Interactive Chinese*, learning Chinese is no longer as foreboding as the *Forbidden City*.

nization of its content. Designed for beginning and intermediate students, *Interactive Chinese* includes a vocabulary builder, character writing exercises, phonics flash cards and drills, and games to help reinforce the lessons. Animations and speech recognition help you master the proper pronunciation of Chinese sounds.

Professional Interactive Chinese for Windows, Version 2.0. List price: \$295. VentureTech Inc., Ardmore, PA; 800-409-8368, 610-896-9150.

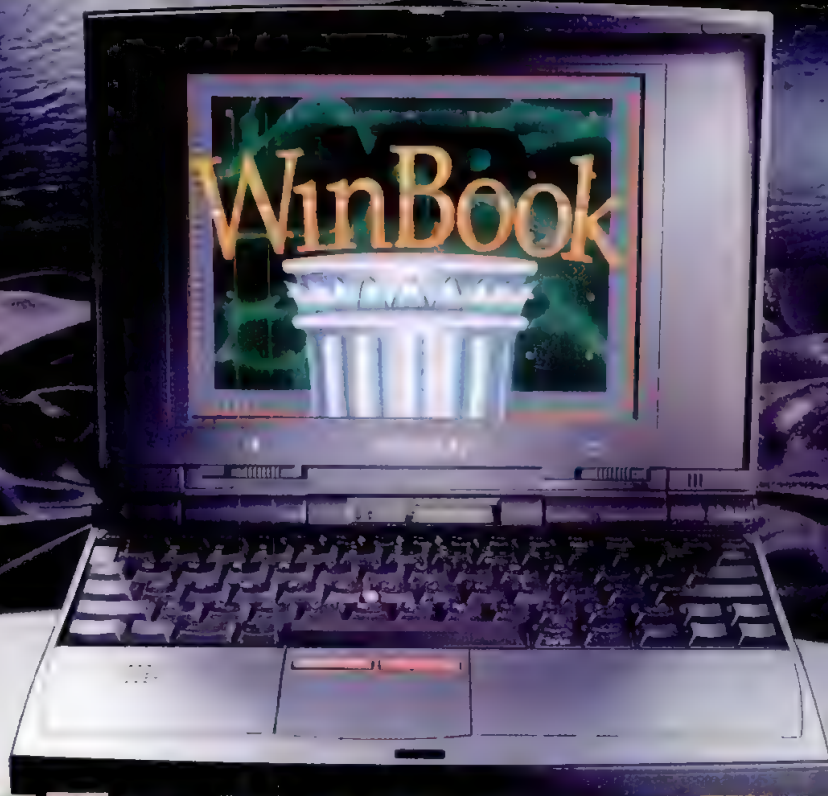
Circle 428 on reader service card

Internet In A Box Now Serves Up CompuServe

Are you considering using an on-line service instead of jumping onto the Internet? Well, now you can have the best of both worlds with *Internet In A Box 2.0*, from the **CompuServe Internet Division**, formerly known as Spry.

CompuServe, which acquired Spry earlier this year, offers this popular one-box solution for ac-

17 Awards and Counting...



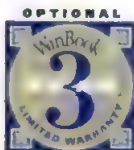
- 1 PC World — Best Buy — May 1995, WinBook XP SX33 8/250 Monochrome
- 2 PC World — Best Buy — June 1995, WinBook XP SX33 8/250 Monochrome
- 3 PC World — Best Buy — July 1995, WinBook XP SX33 8/250 Monochrome
- 4 PC World — Best Buy — August 1995, WinBook XP SX33 8/250 Monochrome
- 5 PC Magazine — Editors Choice — August 1994, WinBook XP DX250 8/250 Monochrome
- 6 PC Laptop — Editors Choice — Most Improved Portable January 1995, WinBook XP
- 7 PC World — Best Buy — February 1995, WinBook XP DX250 8/250 Monochrome
- 8 PC World — Best Buy — March 1995, WinBook XP DX250 8/250 Monochrome
- 9 PC World — Best Buy — April 1995, WinBook XP DX250 8/250 Monochrome
- 10 PC World — Best Buy — May 1995, WinBook XP DX250 8/250 Monochrome
- 11 PC World — Best Buy — July 1995, WinBook XP DX250 8/250 Monochrome
- 12 PC World — Best Buy — August 1995, WinBook XP DX250 8/250 Monochrome
- 13 Laptop Buyer's Guide — Best Buy — July 1995, WinBook XP DX475 8/125 Active Matrix Color
- 14 PC World — Best Buy — February 1995, WinBook XP DX475 8/125 Dual-scan color
- 15 PC World — Best Buy — March 1995, WinBook XP DX475 8/125 Dual-scan color
- 16 PC World — Best Buy — April 1995, WinBook XP DX475 8/125 Dual-scan color
- 17 BYTE — Best Value 486DX4 Notebook — April 1995, WinBook XP

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- 1MB VIDEO MEMORY WITH EXTERNAL VGA PORT
- LCD FUNCTION INDICATOR PANEL
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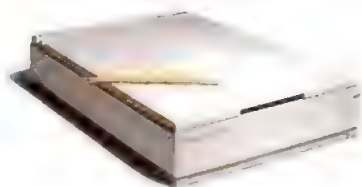
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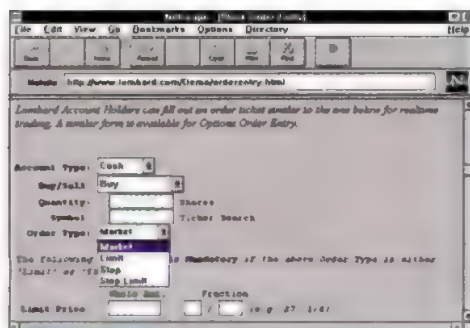
SOFTWARE BRIEFS

cessing the Internet and its on-line service. The \$100 program offers significant integration with CompuServe's included software WinCIM 1.4; other components include the Spry Mosaic browser, e-mail, FTP, a newsreader, Gopher, and telnet. Internet In A Box offers compatibility with hundreds of Internet service providers, but now you can also opt to use CompuServe's global network. Upgrade enhancements include the integration of mail and news into the Web browser and security for transactions over the Internet. **Internet In A Box 2.0.** *Estimated street price: \$100. CompuServe Internet Division, Seattle, WA; 800-557-9614, 206-447-0300; e-mail, iboxinfo@spry.com; Web, <http://www.spry.com>.*

Circle 423 on reader service card

Managing Your Finances Both On-Line...

Lombard Institutional Brokerage is making the investment world more accessible to individuals with its real-time, on-line trading and information network over the World-Wide Web, located at



MONEY MANAGER: Keep tabs on your investments through Lombard's Web site.

<http://www.lombard.com> (see "Net Worth" in Trends). The site, dubbed LIST (Lombard Internet Securities Trading), provides financial services for new and veteran investors. You can sample the services available (including delayed stock and option quotes) or start a Lombard account at no charge and use the full range of real-time services, including the Realtime Quote Server, Portfolio Management, and The Lombard Investment Center. Transactions are protected through Netscape Communications' Netsite Commerce Server. **Lombard Internet Securities Trading.** 800-688-6896. *Web, <http://www.lombard.com>.*

Circle 426 on reader service card

...And Beyond

Charles Schwab & Co. has released an upgrade to its personal investment software StreetSmart. The \$39 StreetSmart 2.0 for Windows integrates additional research sources, including Schwab's Mutual Fund Performance Guide and Reuters

Get a fascinating inside view of the human body with **Research Systems'** CD Visible Human. A \$495 grand tour of the human body, Visible Human lets you explore all aspects of male anatomy, from optical nerves to Achilles tendons, in your choice of three orientations. Visible Human is compiled from 1,800 digital photographs taken of a male cadaver at 1-mm intervals. The CD-ROM also contains extensive magnetic-resonance and registered computer-tomography images for access to nearly 10,000 image slices. A Visible Female is in the works. 303-786-9900.

Joining the crowded upgrade market of uninstall utilities is **IMSI's** \$49.95 WinDelete, Version 2.0 for Windows. The new release monitors applications as they're installed on your system and later removes them by drawing on the information contained in the installation logs. There's also a convenient one-step way to return your system to its previous state should you want to restore deleted files. 800-833-8082, 415-257-3565.

Your old, reliable typewriter has always maintained a useful edge over PCs for filling out forms and applications, but a program like **Virtual Reality Laboratories'** \$69.95 Formbuster 2.1 for Windows demonstrates how narrow that gap has become. Formbuster lets you fax or scan any form into your PC and then fill it out on-screen. Forms are stored as graphics images, over which you can add text and graphics. A \$99.95 CD-ROM version includes a library of commonly requested, ready-to-use forms. 800-829-8754, 815-756-3411.

Are you a CompuServe addict in need of a way to reduce your on-line connect time? Try **Shortcut Software's** Shortcut Guide for CompuServe WinCIM, available for \$14.95 via downloading on CompuServe (type GO SCGCIM) or commercially for \$22.95. This add-in quick-reference utility for WinCIM, is full of time-saving tips and tricks (including how to navigate CompuServe using keyboard alternatives to mouse navigation). 800-521-9414.

Artisoft's LANtastic Power Suite (single-user version, \$199) is an integrated software solution for small businesses that marries the operating system LANtastic with Lotus cc:Mail, Lotus Organizer, Cheyenne Communications' BitWare and BitShare (fax modem and sharing software), and Netcom's NetCruiser for Internet access. 800-233-5564, 520-670-7100.

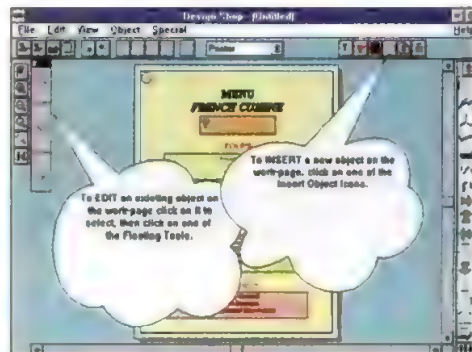
Money Network. Portfolio Reports helps you manage your investment portfolio, while two-way e-mail facilitates communication with Schwab representatives.

StreetSmart 2.0 for Windows. *List price: \$39. Charles Schwab & Co. Inc., San Francisco, CA; 800-334-4455, 415-627-7000.*

Circle 427 on reader service card

Two Ways to Show Off Your Creative Flair

Two software packages are making desktop publishing all the more accessible to small businesses and home users alike. Page Magic 2.0, a \$69.95 program from **NEBS**, satisfies the small-business market's need to produce professional-looking coordinated sales and marketing materials. Fully integrated with NEBS' Company Colors line of preprinted papers, the software formats text and graphics to a chosen style of paper, including letterhead, brochures, and postcards. Page Magic now has more than 170 preset templates, a clip-art library, text special effects, OLE 2.0 support, a screen-capture utility, and color separation for professional printing.



BEGINNER'S TOUCH: DataCal's Design Shop couples flexibility with helpful hints.

By contrast, **DataCal Corp.'s** Design Shop for Windows is a more broad-based desktop publishing program that caters to both home and business. Priced at \$49.95, Design Shop features over 65 templates, 500 graphical objects, and a host of special effects to create everything from banners and greeting cards to business cards, letterheads, and calendars. You can even make coloring books for your kids. The \$69.95 Design Shop Super CD Collection includes over 3,500 images, 226 fonts, an image management utility, and a packet of design paper.

Page Magic 2.0. *List price: \$69.95. NEBS Inc., Nashua, NH; 800-882-5254, 603-880-5100; fax, 603-880-5102.*

Circle 429 on reader service card

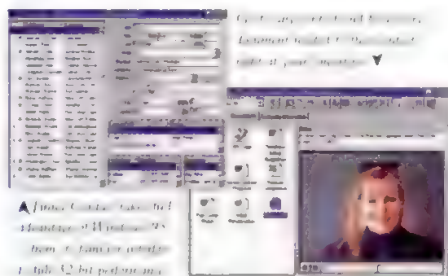
Design Shop for Windows. *List price: \$49.95. DataCal Corp., Chandler, AZ; 800-223-0123, 602-813-3100.*

Circle 430 on reader service card



Eccentric

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Documentcentric

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REVIEWS OF THE LATEST BOOKS FOR THE PC USER

Edited by Tin Albano

Wide Web of Sports

BY CADE METZ

Now that JPEG files of Mickey Mantle's home-run swing and debates on the merits of the designated hitter have migrated into cyberspace, sports fans need to know their way around the information superhighway as well as the barroom.

Whether computer literate or not, serious fans should turn to *Net Sports*, by Kelly Maloni, Ben Greenman, and Kristin

Miller. This athletically oriented, on-line outline supplies everything but the virtual beer.

Each of the chapters, "Hubsites," "Baseball," "Basketball," "Football," "Hockey," and "Sport Cyberpedia," begins with a brief introductory paragraph and launches into a list of worthwhile on-line sites. Each Internet address, on-line keyword, and BBS talk group is accompanied by a 50-word description.

"Hubsites" catalogs the general sports sites that encompass everything from the latest news to trivia to memorabilia. Web pages

such as the ESPN Sports-Zone and commercial-service sites such as ABC Sports on America Online are the most prevalent entries, but smaller sites, such as referee and gambling forums, are also represented.

The four major sports chapters focus on major-league baseball, the NBA, the NHL, and the NFL, but also cover colleges, minor leagues, pools, and rotisserie leagues. Principal sites like the Nando Sports Server and the GNN Sports Center are repeatedly visited, and each chapter closes with a catalog of Net



READ ONLY RECOMMENDS

If you don't have one, you should. And *Prentice Hall's Illustrated Dictionary of Computing*, by Jonar C. Nader, is about as good as it gets when it comes to elucidating the often esoteric technospeak spoken in today's computer age. \$24.95; Prentice Hall, 800-947-7700; ISBN: 0-13-205725-5.

addresses for the primary professional franchises.

The book has an on-line glossary, an Internet providers list, and a collection of momentous sites. The most helpful feature is the sites index, arranged by name, team, school, and subject.

Net Sports' text is not particularly enlightening or even well written, but its lists of sports services are invaluable. Free updates

to the site lists can be obtained via phone (800-638-1133) or via Michael Wolff & Co.'s Web site, Your Personal Network (<http://www/ypn.com/>).

Net Sports, by Kelly Maloni, Ben Greenman, and Kristin Miller, \$19. Michael Wolff & Co. Inc. and Random House, 800-793-2665; ISBN: 0-679-76187-X.

Circle 441 on reader service card

Making Your Own 3-D Games

BY JAY MUNRO

Dust off your high school geometry, brush up on C programming, and get ready for a wild ride through the world of 3-D—games programming with *Amazing 3-D Games Adventure Set*, by Lary L. Myers. The book teaches by example, using Myers's ACK-3D Animation Development Kit engine as the centerpiece. The author states that the ACK-3D engine is an ongoing project, and

along the way he gives tips on improvements you can make to the engine itself, as well as design tips that help you avoid pitfalls and write better games.

With more than 500 pages and a supplementary CD-ROM, the book covers a lot of ground, opening with an overview of the evolution of games, from 2-D scrolling games to the immensely popular DOOM. The author then dives into the sometimes complex math involved in modeling 3-D worlds, using ray casting, the technique used in the ACK engine.

Once the theory of 3-D modeling and math is out of the way, the book gets into the details of game programming. The ACK engine data structures are covered first, laying the foundation for later explanations of functions that control file loading, rendering, movement and collision detection, and screen display.

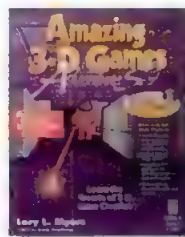
Using the book, the ACK libraries, and your compiler (Borland, preferably), you learn how to start up the ACK engine, open and close doors, draw and use objects, and work with bitmaps. By the end of the book, you'll pull these pieces together to create a 3-D Windows game.

The examples and code presented are the real thing. To maximize performance, the DOS engine uses the 32-bit flat model and is written in C and Assembler (the complete source code is included). Windows programming is also covered, with a port of the engine that uses the Microsoft WinG API in C++ classes, all of which is on the CD-ROM.

In short, the *Amazing 3-D Games Adventure Set* is not a quick read, but it just may help you write the next hot game.

Amazing 3-D Games Adventure Set, by Lary L. Myers, \$39.99. Coriolis Group Books, 800-410-0192. ISBN: 18-883577-15-2.

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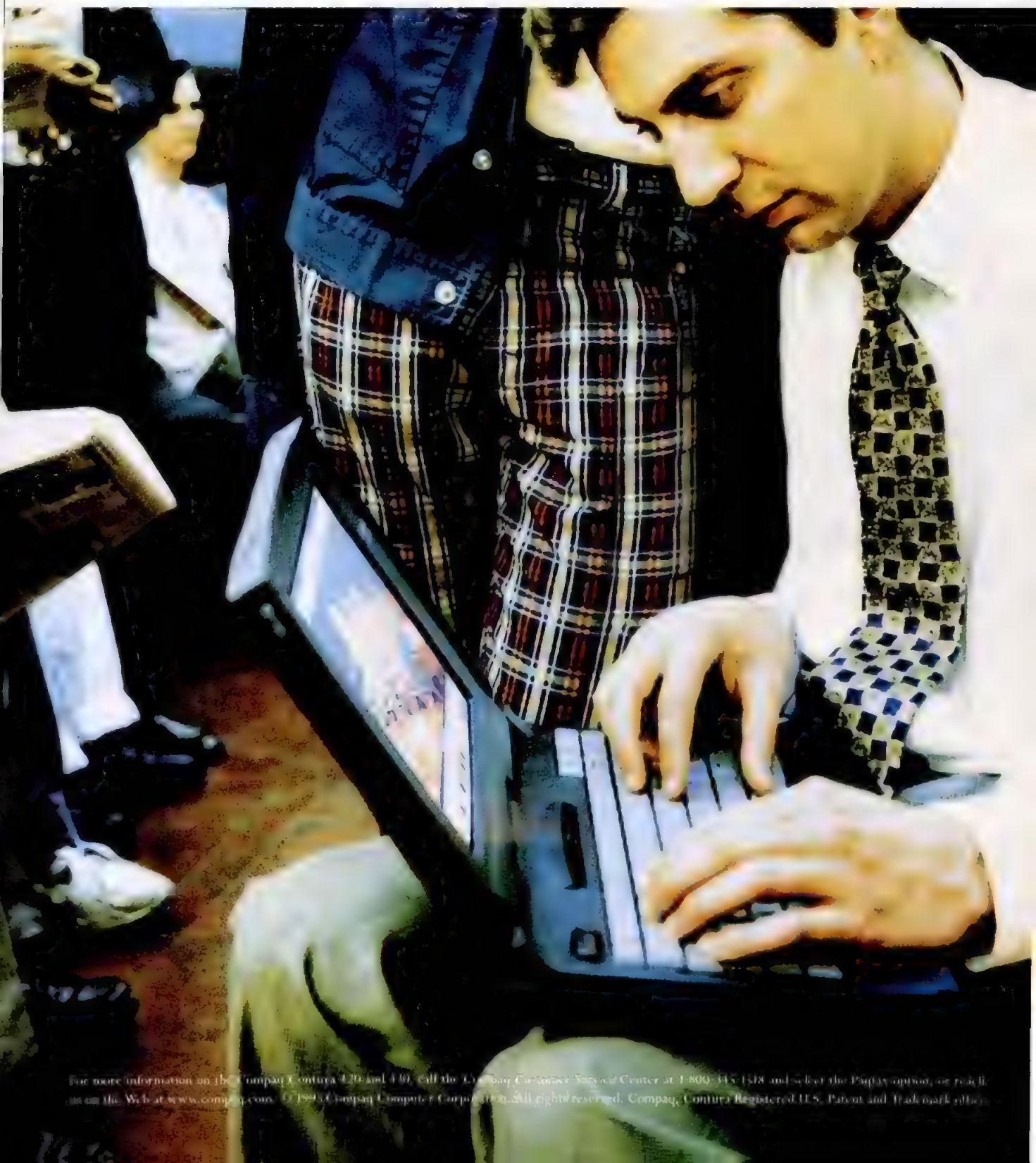
Big Information Sports Page:

<http://www/atm.ch.cam.ac.uk/sports/sports.html>

Sports Illustrated on-line:

<http://www.pathfinder.com/@@8JVAEGCXBAAQHXCS/>

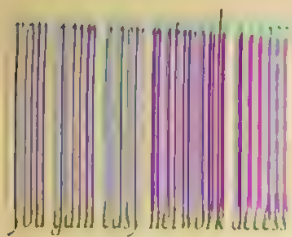
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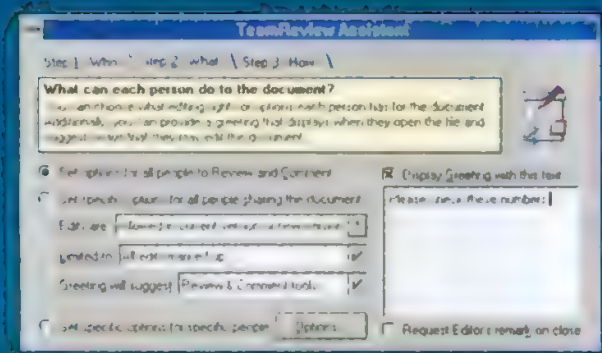


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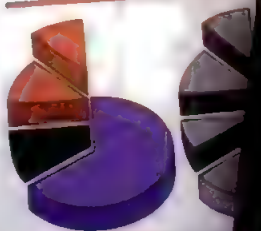
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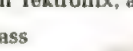
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Michael J. Miller

Windows 95 Is Far from Chicago

Okay, the wait's over and Windows 95 is finally here. You've got it installed and found that it's everything Microsoft promised. Right? Well, not exactly. Windows 95 does deliver on the basic promises: It's a 32-bit, protected, multitasking operating system with a better user interface than Windows 3.1.

The operating system's features, however, have changed a bit as Windows 95 has evolved from its "Chicago" days. Microsoft has removed some features, added new features, or placed them in the Microsoft Plus! add-on kit.

Let's look at some of the places where Microsoft Windows 95 may be a little different from what you might have expected.

MUCH ADD ABOUT DOS

The best place to start is with the most basic features of the operating system. Many people were surprised to find out how much DOS there still is in Windows 95. You go through a DOS mode on booting, you can boot in DOS without Windows, and the operating system supports many DOS interrupts, structures, and device drivers. Microsoft says that the DOS support is for compatibility.

So what's the fuss about Windows 95 having DOS compatibility, and the fact that it still runs "real-mode" device drivers and programs that could take up its resources or even crash the whole system? Why do statements that provide descriptions of Windows 95's DOS compatibility, such as those in Andrew Schulman's book *Unauthorized Windows 95* (Read Only, April 11, 1995), attract so much attention?

The answer is really very simple. Microsoft employees were not very clear when they started talking about "Chicago" a couple of years ago. They made statements such as "Chicago is a 32-bit operating system that does not require or use a separate version of MS-DOS" and "Chicago is built from the ground up to be a 32-bit preemptive multi-

tasking operating system. Therefore, the system is not bound by the constraints of MS-DOS." All of these things are true in broad outlines, but there is a bit of exaggeration. There are some parts of Windows 95 that use existing 16-bit code, and the OS does have some DOS constraints.

CHANGING EXCHANGE

Among the essential features of Windows 95, the one that changed the most was Exchange. Originally called Info Center, Exchange was designed from the start to be a universal in-box for multiple mail servers. As shipped, Exchange will let you send and receive mail for Microsoft Mail, CompuServe Mail (through a driver that comes on the Windows 95 CD or can be downloaded), and mail from the Microsoft Network (MSN). But several features have been stripped down, including sorting and grouping by services, and advanced features such as shared folders. This, of course, leaves more room for third-party vendors—and Microsoft itself—to sell more advanced mail clients.

A lot of communications functions were added since Microsoft first began discussing the operating system, the most obvious one being the Microsoft Network, which attracted so much controversy over being bundled with the OS in the first place.

Several minor accessories have also changed. WinPad, a basic personal information manager, appeared in early test versions of Chicago but disappeared a while back. Schedule+, the group scheduling package that's included with Windows for Workgroups, is not going to be included with Windows 95. Schedule+ will now be a part of Microsoft Office.

Unlike the last few revi-



*The Windows 95 you unwrap
may not be everything
you thought it would be.*

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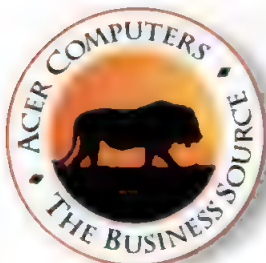
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Bill Machrone

Disabling Technology

Every once in a while, you need a whack upside the head to shake you out of complacent modes of thinking. I got a recent wake-up call when my ten-year-old son brought a booklet home from school titled "If I Were the Richest Kid in the World." The

children in his class had written what they would do with unlimited funds, and had further described what they would wish for if they could have any wish. Most of the kids said they wanted to buy things like big houses with amusement parks in the backyards or new Dodge Vipers for their parents. Some wished for the rain forest to be protected or houses provided for the homeless—suitably noble acts. One girl had a very simple wish: to be able to do something with her right hand.

She has cerebral palsy. Between her wheelchair and walker, she gets around pretty well. At school she sits at a special desk that surrounds and supports her. Like any ten-year-old, she enjoys working on the computer and plays games, including some shoot-'em-ups like DOOM. That got me to thinking: What would it be like to use my computer with only my left hand? And how would I use a mouse if my brain kept sending random commands to my arm muscles that caused my hand to jerk away sharply from its intended direction? The very technology that makes life easier for most of us can make it much harder for others. Enabling technology becomes disabling technology.

Likewise, multimedia CD-ROMs are a boon for most of us, but what good are audio clips if they're inaudible to part of your audience? Dana Mulvany, a licensed clinical social worker who is also hard of hearing (and worked on the Americans with Disabilities Act), has been corresponding with me regarding the nature of enabling/disabling applications. She writes: "Quick-en's Deluxe CD-ROM uses audio files and doesn't supplement them with text files. There's no indication that this CD is inaccessible to people with severe hearing impairments. In contrast, Cinemania '95 provides both audio and supplementary text files. (It's quite wonderful to understand the

dialogue from classic movies for the first time.)"

Pardon my stupidity, but it never occurred to me that a hearing-impaired person might have caught the tone but not the actual words of Bogart's marble-mouthed "Here's lookin' at you, kid." Such catchphrases are part of our common culture. Not to share in them is a terrible form of exclusion. Another smack upside the head. Mulvany has written an informative, thought-provoking, well-balanced article titled "Differing Abilities," which can be found at <http://www.penworld.com/is16/differ.htm>.

Mulvany's comments have increased my appreciation for Web sites devoted to popular musical groups. Many of them contain the complete lyrics of songs. A visit to one of these sites is an ideal way for a hearing-impaired person to enjoy the music. Whether the lyrics are puffery or poetry doesn't matter. It's access.

Perhaps there's a simple solution to the mouse problem. Why not build the mouse driver so that it ignores fast movements and responds only to slow, deliberate ones? Other problems are not so simple. Windows 95 has some nice enabling-technology features, but I hope that its accessibility options will be thoroughly debugged. In current betas, you can turn on some options by pressing the Shift key five times, which also crashes some DOS programs. Graphical environments still have a way to go to support blind users. Win 95 is supposed to have hooks that let ASCII-driven, text-pronunciation modules read on-screen graphical text, but I haven't seen it yet.

One final whack: At your request, I've been including phone numbers when I've mentioned products here, but many of you then e-mail me for fax or e-mail contacts. Whether a barrier is related to time, language, hearing, or speech, it's surmountable. I'll start including those numbers. □



Technology that makes life easier for most of us can make it much harder for others.

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Second Looks

LIVING WITH THE PRODUCTS WE REVIEW

Readers Speak and I Listen to the Ecco

Eccho Professional users did not take very kindly to my remark, in our July 1995 issue, about the company's seeming lack of responsiveness to suggestions from users. They pointed to the newly released Ecco Professional 3.0 as proof that NetManage, the parent company, cares. Inspired by the amount of reader mail I received, I decided to have a close look at Ecco Pro 3.0. Here's what I found.

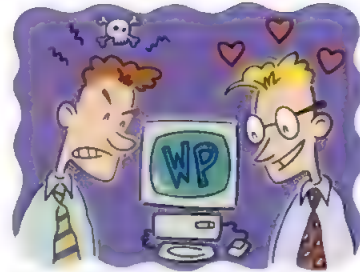
Ecco Pro 3.0 addresses all the criticisms of the previous version and has some cool new features that go beyond even the most demanding user's requests, such as the ability to store World-Wide Web site addresses in an outline and launch a Web browser by clicking on them (not a totally surprising feature, since NetManage is one of the leading vendors of Internet connectivity software).

Some bugs, however, are evident

in Ecco Pro 3.0. One of the most prominent is the inability of the Shooter (Ecco's innovative way to send data to other applications) to send private addresses. Users have posted several workarounds including a shareware add-on, Toolkit 3.0, available on the Ecco forum on CompuServe.

Ecco keeps two backups of your data file, so total data loss is commendably rare. A corrupted file will crash your system, however, and the backups occasionally get corrupted, too. Users are clamoring for Ecco to release its scrubbing program that fixes corrupted files, but this task is best left to the tech-support experts. Some users have cured file corruption and resulting GPFs by installing Ecco Pro 3.0 in a new directory instead of upgrading over Ecco Pro 2.0.

Although I've installed Ecco Pro 3.0, I don't know if I'll stick with it. It's incredibly feature-rich but requires the same devotion as a Day-Timer or a Franklin Planner. Meanwhile, I eagerly await the first maintenance release.—BM

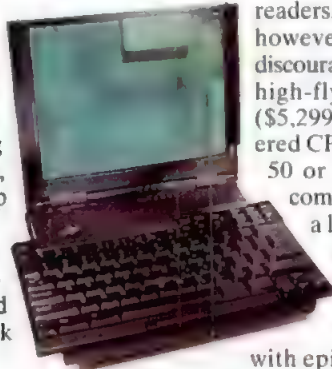


WordPerfect and Windows: Still Struggling

The WordPerfect battle continues. Letters from readers are unabated—and unresolved. Half the letters trash us for being so hard on such a wonderful program; the other half trash WordPerfect 6.1 for being a piece of junk. Although it has its staunch defenders, the number of people still having problems with WordPerfect for Windows leads us to believe that you should be cautious. Happy users are publishing books, mail merging, the works. Unhappy users are deleting it from their hard disks.—BM

Butterflies Aren't Free Or Easy to Catch

When IBM's Butterfly notebook first alighted at *PC Magazine*, even our most jaded editors rushed to see the latest technomodel, the ThinkPad 701C, with its much-anticipated folding keyboard. Oohs, ahhs, and wows—followed up by a most favorable review (First Looks, March 14, 1995)—stamped this ThinkPad the hottest notebook around.



How to contact Second Looks: On ZD Net type GO ZNT:EDITOR, and choose Views: Machrone. Contact Machrone directly via MCI Mail at Wmachrone or CompuServe at 72241.15. You can also find us on the World-Wide Web at <http://www.ziff.com/~pcmag>.

Since the 701C's arrival, I've been patiently waiting to hear the reactions from our usually vocal readers. Potential buyers, however, were probably discouraged by the 701C's high-flying price tag (\$5,299) and underpowered CPU options (DX2/50 or DX4/75), so incoming mail has been a little slow. For the most part, the letters I've read have been positive, peppered with epithets like "great keyboard" or "wonderful screen." One reader went on to say that "the 701C has changed the way I work. Its full-size keyboard is so nice to type on that I hardly find myself using my desktop PC any-

more."

The 701C's enhanced parallel port/external floppy connector is certainly innovative, but some readers had difficulty finding printer cables that fit this new form factor. One thing is clear: IBM has broken new ground in notebook design. Now if it could find a way to get a Pentium into the 701C while lowering the price, we would see a rush of people trying to catch butterflies.—TA

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- ▶ Microsoft mouse
- ▶ MS Windows® 95, or MS-DOS 6.2 & Windows for Workgroups 3.11
- ▶ MS Works 95, or MS Works



John C. Dvorak

Grandma's Old Computer

Every so often I promote the notion that everyone should buy massive amounts of computing power and swap it out every few months for the latest and greatest. Whenever I do, I get a slew of letters from haggard readers who say that they can't keep up.

Until recently, I didn't understand these objections.

You see, my mother-in-law has an old Compaq 386/16 that my ten-year-old likes to play with when he visits her. One day he decided to install Windows on the old machine, and I told him that the machine was unlikely to run Windows at all. I argued that this thing was a clunker, designed for Grandma to use for running WordPerfect for DOS, with a Courier font for printouts. I figured it had a megabyte of memory, maybe.

The kid insisted, found a copy of Windows on my shelf, installed it, and announced that it worked. I soon found out that the machine had 6MB of memory, and indeed Windows was running fine. We needed a mouse and installed one of the new Logitech designer mice.

Curiously, the machine seemed rather snappy even when compared with my Micron 133-MHz Pentium system. Of course, this machine had virtually no overhead: no TSRs, no device drivers, nothing. I then went on CompuServe, downloaded a Windows driver for the Canon BJ-200 printer, and suddenly discovered Grandma's fonts.

A week later Novell sent me the latest copy of WordPerfect for Windows, and my ten-year-old decided that Grandma should have that instead of the DOS-based WordPerfect. He tried to install it, and lo and behold, the 40MB hard disk was full. Then I recalled that in one of my closets (no sneering) I had a Plus Development 80MB hard card of the same vintage as the Compaq system. I popped the hard card in, and with hardly any hassle the thing was running just fine.

Anyway, the additional 80MB helped Grandma's system enormously. My kid installed WordPerfect for Windows, and it worked just fine. Now Grandma can use sophisticated fonts. The

kid made one comment afterward: "It's slow, but it works." Maybe I'll try to drop in one of those upgrade chips to soup it up a little.

The point of all this is that it's fun to modernize a clunker without breaking the family budget. If you've got the money to move to 2.3GB, just do it. Most people don't have the cash to jump from a horse-drawn cart to a starship and need to consider alternatives. In the case of this computer, an old hard card, which can't be worth more than \$50 in today's market, did the trick.

It struck me afterward that an interesting motif was evolving. One was the "fix up the old jalopy" idea that American men have always been attracted to. The kinds of tinkerers who used to install dual four-barrel carburetors on '55 Chevys have no '55 Chevys today to work with. Instead they have old computers to soup up.

There's not much to upgrading a new machine, but there is with old ones. It's with old PCs that this time-tested hot-rodding/tinkering paradigm is in full force. Upgrading Grandma's PC, I felt what my dad must have felt when he replaced the old, fading 6AU6 tube from the Philco TV set. He was the household hero, and the set was once again whole.

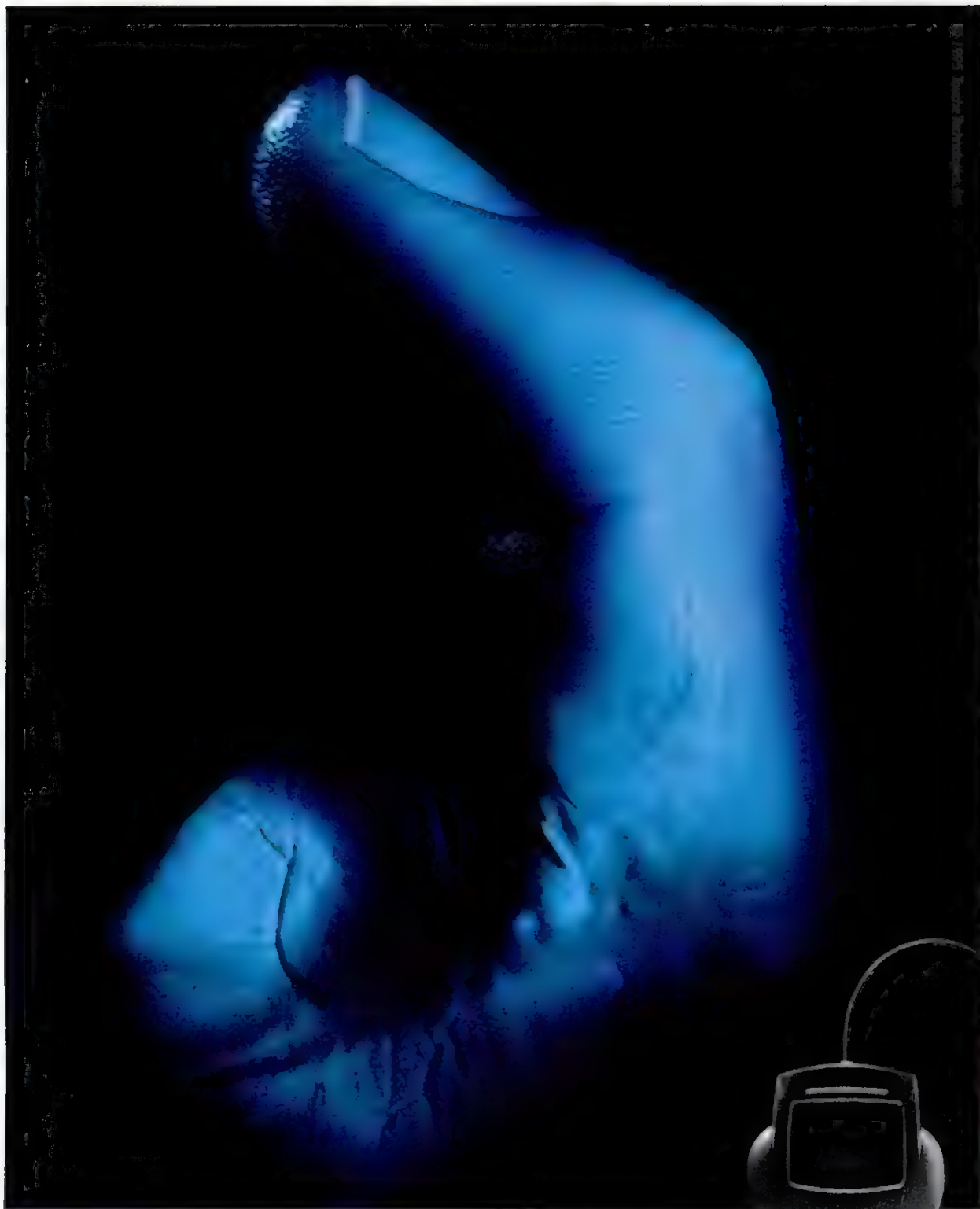
Today we'd be more inclined to junk the old set and buy a new one. Anyone can do that. That's why so many people (men, mostly) get bent out of shape when I tell them to junk their old PC and buy a new one: Hey, anyone can do that.

I suppose anyone can. Maybe upgrading an old PC such as Grandma's is the last thing a man in this society can do that most women don't care to do. Maybe that's why I get an inordinate amount of mail concerning old clunkers. Having worked on an old clunker, I now understand the issue. My apologies.



*There's not much to
upgrading a new machine,
but there is with old ones.*

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John C. Dvorak Inside Track

Cyrix is in the news with a version of its **Pentium clone**, the M1, a chip the company has been talking about for years. The company has moved ahead with a modified version of this chip called the M1sc—which looks a little like the abbreviation for the word miscellaneous. This processor will be sold with the **moniker 5x86**, implying 586 or Pentium-class performance.

The lack of certain features makes this something of a stretch, but less of a stretch than Cyrix's first 486, which was closer to a souped-up 386 CPU than anything else. Still, the company believes that it is **performance that counts**, not design details. It appears that this chip will blow away any 486 on the market, and it comes close enough to the Pentium (at a cheaper price) to be bothersome to Intel.

The **interesting irony** concerning all this is that if anyone clones an Intel chip to the point where the clone is an exact copy, Intel will take them to the cleaners in a legal battle. What you want is exactly what Cyrix is doing: designing and manufacturing a high-performance processor that is Intel-compatible but not a perfect copy.

Another company coming close in the clone race is Taiwan's UMC—one of the few offshore clone-makers **worrying Intel**. Intel has sued UMC over a 486 family of chips that the company has developed. It's feared that UMC has a Pentium clone in the back room.

Buy-Out Fever Dept.: If you haven't noticed, since IBM purchased Lotus, almost every major software company is now a buy-out candidate. Rumor has it that **Borland** will be bought by **Novell** (again) or maybe IBM (again). Novell is also supposed to be bought by IBM (again). In the meantime **Symantec** quietly bought **Delrina**. The thinking behind that purchase is somewhat mystifying. Anyway, it looks like the industry is about to implode. Stay tuned.

More Microsoft Paranoia Dept.: Have you ever wondered why Microsoft out-of-the-blue decided to **change the Windows interface dramatically**? The company got wind of a number of Windows 3.11 clone projects. The Windows 95 zigzag will **ruin** the chances of anything coming close, which leaves Microsoft in the driver's seat for the next few years.

All the company really has to worry about now is **counterfeit copies**. While Microsoft supposedly has 80 guys (Microsoft Security) **locked in a basement in Redmond** calling all the BBSs in the country looking for pirated copies of DOS, Windows, and Word, it still relies on outside groups and the police to stop software

Anticounterfeiting

is the real reason

Microsoft is so

adamant about bundling

Microsoft Network

in Windows 95,

and why it told the

Justice Department to

take a hike.

counterfeiting. With cheap printing and **cheap holograms** available in China, you can expect a **deluge of fake copies** of Win 95 available worldwide very soon.

Anyone who doesn't think that the impetus behind Microsoft Network is to stop the counterfeiters needs to take a refresher course in Finance 101. At first, the Microsoft Network (MSN) will minimize counterfeit copies of Win 95 in regions of the world where you can call a local access number. Although it wouldn't surprise me if Microsoft would arrange for the MSN module to make an international collect call for registration from countries like South Africa and Singapore, where **piracy is common**. Of course any good hacker could defeat that. If you

ever get the message "Microsoft Network Module not available with this version of Windows," I'd be suspicious.

Anyway, anticounterfeiting is **the real reason Microsoft is so adamant** about bundling MSN and why it told the Justice Department to take a hike regarding removing MSN from the package.

Let's face it, there will be **millions of counterfeit copies** distributed all over the world. Don't think in terms of the drug trade. Think in terms of the billions of dollars worth of illicit fireworks sold by Hong Kong gangs. What will happen is that perfect copies of Win 95 will be distributed through an underground network and sold by small clone-makers worldwide. The cheap price of the counterfeit copies will give these low-ball cloners a competitive edge.

Nobody will be able to detect the counterfeit, either. An **elaborate** serial number system combined with MSN will be the only way to uncover any abuse. The hundreds of millions of dollars in potential lost revenue saved will allow MSN to make on-line deals at a loss—at first. This is why they will do a 70 to 30 split with the network's content providers (sometimes called publishers in this scheme). The providers get the 70 percent! AOL and CompuServe take 70 percent of the action.

These publishers/providers will flock to MSN under this arrangement, ensuring its success. This will allow the network to grow overseas, where it will be a Win 95 counterfeiting watchdog in more and more countries until bogus copies are abolished. **Once abolished**, the cost justification will end, and the 70 to 30 split will end too. The argument will be made that since there are no other competitive services, and since the number of MSN users is so high, a 30 to 70 split will still garner a publisher a ton of money. The eventual model will be closer to a book publisher's: Microsoft will consider itself the publisher and pay 15 percent to providers. Give this about five years to unfold. □

Some people will be able to run Windows[®] 95 without more memory.



Like David Copperfield and Siegfried & Roy to name a few. But of course they can pull rabbits out of hats, make elephants disappear, and other incredible feats of magic. If you can do that, you'll be able to run Windows[®] 95 just fine. But if you're a bit more ordinary, you're probably going to need massive memory upgrades! That's because while the typical PC has only 4Mb RAM, you'll need a minimum of 8Mb RAM just to load Windows[®] 95, and 16Mb to create anything magical at all. But you certainly have a choice. You can call David Copperfield, or you can call for the Viking dealer nearest you.



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Jim Seymour

ZIP Tricks: First, Find One for Sale

Iomega's new ZIP drive may not be the product of the year, but it's certainly been the hottest PC hardware product this summer. Dealers faced lines of angry buyers who couldn't understand why the stores couldn't keep them in stock.

Even Iomega underestimated the demand for a \$200 drive that uses \$15 to \$20 100MB disks that are just a bit larger than 3.5-inch floppy disks. Throughout the summer, ZIP drives have stayed on back order at most computer outlets. Many dealers kept waiting lists, some demanding full payment in advance to hold a place on a list. I saw a frustrated buyer offer a clerk in an OfficeMax store a \$100 premium over the store's \$200 price for what was expected to be their last ZIP drive for a month or more. (I'm happy to say the clerk didn't take the bribe.)

This is one *hot* product.

And not just because it's cheap. I'm convinced a good part of the ZIP's success is due to its easy parallel-port hookup. Parallel-interface devices have come into their own over the past couple of years, and now offer a reliable way to connect a PC to a variety of peripherals. PC users often hate going under the hood of desktop PCs, and, of course, notebook users haven't got a hood to go under. With faster and smarter EPP and ECP parallel ports, with the new and fast Direct Cable Connection option in Windows 95, and with Parallel Technologies' new active-electronics Universal Parallel Cable, we're going to see a lot of interest in parallel data transfers.

As you may have guessed, I'm a big fan of ZIPs. Although other innovative, small-form-factor storage products are in the stores now and in the pipeline for delivery this fall and winter—including SyQuest's new EZ135 drive; Iomega's JAZ, a \$500 1GB big brother to ZIP that uses \$100 disks; and the new Compaq/3M/Mitsubishi 120MB 3.5-inch floppy—I think the ZIP's going to remain the high flier. I'll probably buy one of Iomega's 1GB JAZ drives, too, for other uses, but ZIP is going to have legs—in the showbiz sense.

Here are a few tips for all you potential ZIPpers out there, and for users of other parallel devices as well.

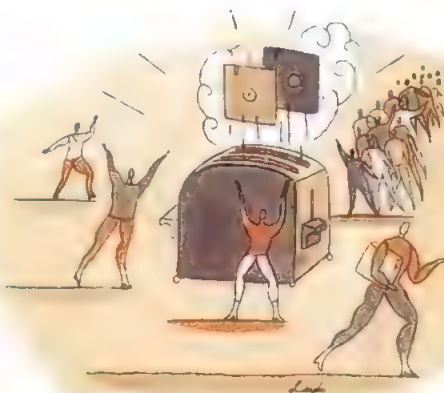
• **Buy Parallel.** The ZIP drive is available in external parallel-port and SCSI versions, and in an internal SCSI version. The external parallel-port box makes a lot more sense for most users. The ZIP drive itself is so light and small that it's a trivial task to move it from machine to machine or carry it on a business trip when necessary. Making the parallel connection and installing the ZIP software on a new host machine are also both quick and easy. SCSI may make sense for the internal ZIP drive—and buys you a speed improvement—but the soul of the ZIP drive is in the parallel-port version.

• **Buy a Lot of Disks.** You're going to use your ZIP drive for archiving, in a sort of semi-on-line backup system for big and aging files you don't access very often. You're going to make ad hoc backups. You're going to use PKZIP to pack *lots* of old stuff onto ZIP disks. You're going to use ZIP disks to send desktop publishing files to service bureaus. You're going to send ZIP disks to colleagues and friends. In short, you're going to need a lot of disks. Buy 'em in ten packs for \$150 or so from the usual discounters and mail-order firms.

• **Dump the Power Supply.**

As with all too many PC products, the power transformer for the ZIP is ludicrously large and heavy. Iomega has a much smaller and lighter version, which also works with most foreign voltages; it's available for \$39.95 (800-777-6654). That's expensive—and it ought to be included with the drive—but it's worth it if you carry the drive around much.

• **No Booting, but . . .** You can boot from a ZIP drive on a Macintosh system, but not on a PC. But a ZIP disk is a wonderful place to stash extra copies of all that junk



The ZIP drive itself is so light and small that it's a trivial task to move it from machine to machine.

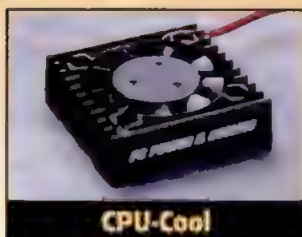
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Jim Seymour

in your Windows directory and its subdirectory: a whopping 74MB worth on the machine I'm using right now. If you use PostScript fonts and ATM, you also have a PSFonts directory (another 5.5MB on this machine), which you should copy to the ZIP disk as well. Just remember that you'll still need a 3.5-inch floppy recovery disk to boot from in case of disaster.

• **Buy an Extra Cable.** Crawling around behind your PC to disconnect and then reconnect any parallel-interface peripheral is a pain. So use an old LapLink serial-transfer trick to make life easier: Buy a standard M/F DB25 serial cable, with all 25 lines wired straight through. Connect one end to the parallel-port DB25 on your PC, then route the cable to some convenient spot—say, under your desk. Connect the ZIP's parallel-port gizmo there, hook up the printer pass-through, and you're in business. Moving that parallel device, or swapping it for another, will be a lot quicker and easier.

• **Illegal Daisy Chains.** With parallel-interface add-ons becoming more numerous and useful, it's frustrating to have to keep connecting one and disconnecting another; after all, as the manual always says, *You absolutely cannot connect anything to the printer pass-through port other than a printer.* A little secret among friends: *You can often daisy-chain a second parallel-port interface onto the first one,* connecting your printer to the end of this illegal daisy chain. It won't always work, and you didn't hear it from me, but . . .

• **Give ZIPs to Others.** I've already given clients two ZIP drives, and I'm sure I'll buy and give away more. "Consultant Subsidizes Multibillion-Dollar Corporations?" Sounds goofy, but it works. I often exchange big databases and other huge files with my clients. It's always clumsy. CD-Rs (recordable compact disks) are one answer, but only if you have a megabuck CD-R drive. Twice this summer, I've bought and sent to clients parallel ZIP drives, then started shipping data back and forth to them on ZIP disks. They love it, I love it, and we both save money along the way. Cheap at twice the price. And do they ever think I'm a generous guy . . .

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Bill Howard

Winners and Losers in '95

With Windows 95 just arrived and Intel's P6 CPU due to ship by November for Fall Comdex, the world of personal computers is due for big changes. I've been thinking about the pending shake-up, and here's my take on who wins and loses.

Windows 95 will be the big winner everywhere. No surprise here. Conventional wisdom says adoption will be quick for the home market and leisurely for business. On the first part, I agree. Windows 95 has been on every consumer-oriented PC since its August 24 ship date.

I believe businesses will take to Windows 95 more quickly than expected, for two reasons. First, there will be a feature or two that improves the lot of virtually every user, whether it's the ability to use multiple networking protocols without choking your PC, install hardware seamlessly through Plug and Play, or use longer filenames. Second, proving that water can wear down a stone, entire departments of end users asking, "What's with this 'go cautious' policy?" will speed the adoption of Windows 95.

P6 questions. Intel never hid it, but it never took out ads to warn you either: The P6 was designed as a 32-bit operating-system CPU ever since it was hatched back around 1990. Which means that the P6 can run 16-bit operating systems and 16-bit applications, but not very quickly. In fact, in some cases, apps will run *faster* on a same-speed Pentium than on a P6. Bet you didn't know that. We believe Windows 95 is not the kind of 32-bit operating system that gives you a noticeable speed boost on the P6. Windows NT is, when coupled with 32-bit applications. OS/2 might be, but Intel hasn't spent much time performance testing OS/2 on a P6.

The real-world performance jump from a 486 to a first-generation Pentium was better than 50 percent. Going from a Pentium to a P6 gives you something like 30 percent to 50 percent more performance, we believe—provided you're running Windows NT with 32-bit apps.

Second chance for AMD, Cyrix, and NexGen. If the P6 doesn't turn out to be a killer on mainstream

performance, then the vendors of Pentium-class CPUs get second leases on life. It matters less that AMD's K5 has slipped to early 1996, that NexGen has been slow to gain market acceptance, and that the die size (the chip size without the ceramic or plastic packaging) of Cyrix's M1 in current form is only slightly smaller than that of the army tank bearing the same name. Cyrix also has a Pentium-lite processor called the 5x86 (née M1sc).

Intel has a 150-MHz Pentium ready to go (it should be announced by Fall Comdex) and has been mulling whether to make 166-MHz or 180-MHz Pentiums or both. I suspect you'll see Intel produce them to counter the competitors' Pentium-class offerings if the shift to P6 isn't so quick.

Windows NT may be a winner. Relative to its current installed base, that is. If you've made the hardware investment to run Windows 95 (16MB of RAM, a 1GB hard disk, and a Pentium/75), you can run Windows NT, too, and then you've got the operating system that makes sense for P6 PCs also. The only problem is that the NT version you want, code-named Cairo, is still a year away. The NT you buy today doesn't have Plug and Play or the new Windows 95 interface, and it really prefers 32MB of RAM.

RISC CPUs will struggle. If Windows NT takes off, it shouldn't make a difference whether you're running an x86 CPU, Digital's Alpha, NEC's MIPS, or the IBM-Apple-Motorola PowerPC. Whether that translates into more market share remains to be seen.

Return of the annual software license. It doesn't take a rocket scientist to figure out that if there's a Windows 95, there's likely to be a Windows 96. We've already seen products with annual refreshes at the same time of year, such as CorelDRAW in the spring and Intuit Quicken in the fall. Microsoft has simply used a year for the rev number. □



Microsoft Windows 95 is going to shake up the computer world. Who will be the winners and losers?

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NETWORK EDITION

ISDN ROUTERS

ISDN Picks Up the Pace

The long wait for businesses and users is coming to a close: ISDN is more widely available, and products are improving.



By Shawn F. Kafaipour

Accessing remote LANs from a branch office or from home used to be considered a luxury, available only to those few who could afford the costly hardware and the expensive monthly bills for leased lines. Not any more, thanks to ISDN and ISDN routers.

Up until now, ISDN (Integrated Services Digital Network) hasn't exactly been a smash hit, mostly because state regulators and reluctant phone companies haven't promoted it very well. But that's all changing, and rapidly. ISDN has finally started to get the respect it deserves, and its appeal has widened since it has become available in most parts of the country. Local telcos are getting better at

INSIDE



Will 1996 be "the year of ISDN"? This popular technology is certainly poised for a breakthrough season, with regional telcos, U.S. businesses, Internet Service

Providers, and users all finally understanding and appreciating its unique mix of availability, speed, and price.

WE ASKED ZD LABS VETERAN Shawn Kafaipour to give us an update on the ISDN router market. Kafaipour reports noteworthy improvement in ease of use, interoperability, and reliability for these versatile products. Especially good for the remote business user, an ISDN router can act as a faster link back to the corporate LAN and as a high-speed connection to the Internet.

ANOTHER TECHNOLOGY, Hierarchical Storage Management (HSM), is also finally looking as if it has star quality. HSM gets a boost from some recent releases that make it easier to buy into. Contributing editor Steve Rigney reviews packages from Cheyenne and Palindrome in First Looks. Palindrome's Storage Manager is especially appealing, with backup, archiving, and HSM all built into one well-priced package.

SENIOR TECHNICAL ANALYST JOHN

Garris, long an observer of the Unix market, gives us some good news in his first look at SCO's Release 5 of OpenServer. This is a complete overhaul, says Garris, and gives SCO its strongest chance yet for breaking in big to the Intel-based network market.

AND FOR YOU WINDOWS NT FANS,

we've got a first look at Batch Services for NT, a package that brings NOS functionality to Windows NT. This makes Windows NT more attractive as a base for batch-processing applications. These NOS vendors aren't waiting for the eternal flame to reach Atlanta next year. They say: Let the games begin now.

—Gail Shaffer

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installing ISDN and are offering rates that rival those for analog lines.

Some providers even offer residential flat fees for local calls, which makes ISDN an attractive alternative for telecommuting and Internet access. It is only a matter of time before ISDN becomes the wide area network darling of the industry.

Recognizing the vast potential of ISDN, many vendors have developed products to take advantage of its strength as a WAN connectivity solution. In this roundup, we review four ISDN routers from leading vendors: Ascend Communications' Pipeline 50, Combinet's Everywhere 2060-RO, Symplex Communications' DirectRoute Remote RO-1, and Telebit Corp.'s NetBlazer LS ISDN. (DigiBoard and Rockwell could not make our roundup deadlines, and Cisco chose not to participate.)

Most of the vendors in our review offer many models of ISDN router, ranging from those designed for a small-branch or home-office solution to those intended for larger sites and even as backup for corporate backbones. Our review focuses on the low-end routers targeted at smaller branch offices and telecommuters accessing remote LANs or the Internet.

EASY TO LIKE

ISDN has several key elements in its favor. First, it is a dial-up solution rather than a leased line, which means you pay only for what you use—just as when you use your phone or modem. But unlike a modem, which transmits over analog circuits, ISDN

is a digital service that dramatically increases transmission reliability and cuts down on error rates. It is also faster than the fastest modem transmissions possible today.

The ISDN routers in this roundup generally have two connections: a WAN port that connects to the ISDN line (just like a modem port that connects to the phone line) and a LAN port that is often an Ethernet connection. The routing software is included with these modem-size routers and most have a built-in network terminator (NT-1)—the piece of hardware required to make the conversion between ISDN's two lines and the router's four. We recommend buying a router with a built-in NT-1.

These low-end devices cost less than \$1,500 on the average. But if you only need to access your LAN from home occasionally and buying an ISDN router is not in your budget, consider a less expensive solution, such as an ISDN terminal adapter or an ISDN modem. These products don't come with the network capabilities—or the dollar overhead—that the routers do.

LINE UP FOR ISDN

ISDN service is available in two flavors, basic rate interface (BRI) and primary rate interface (PRI). Each BRI ISDN line consists of two 64-Kbps Bearer channels (B channels) and one 16-Kbps signaling channel (D channel). Together, this combination is referred to as 2B+D. PRI provides 23 B channels and 1 D channel (23B+D), which deliver speeds equivalent to a T-1 link.

Our product set includes routers that can

handle simultaneous IP and IPX traffic (as a minimum) and use a single BRI line for the WAN connection. All the products we looked at have the capability to use both B channels as a single pipe for an aggregate throughput of 128 Kbps uncompressed.

Because these products are low-end solutions, we were looking for good marks under ease of configuration and use. We wanted to see a fairly seamless and transparent solution, but overall we didn't. Our testing revealed that most of the vendors need to refine their command-line interfaces and nonintuitive setup schemes.

With the exception of Symplex's DirectRoute, which was by far the easiest and most intuitive router to set up and operate, this group needs a complete overhaul of their user interfaces. In fact, Telebit's product proved too cumbersome for us to recommend as a dial-up routing solution for small-office/home-office environments; setting it up requires expert help, which is usually not available in the kinds of locations for which these routers are suited.

Designing an intuitive user interface for a router clearly is a challenging task for the vendors. But without one, many useful features may never be utilized simply because users aren't aware of all the power that's hidden beneath a cryptic interface. There are many issues involved in router management and optimization that may not be resolved with a simple call to tech support.

Our performance tests focused on each router's ability to combine both B channels effectively (either by channel bonding

GLOSSARY

The ABCs of ISDN

BOND Bandwidth on demand; in ISDN, the ability to aggregate B channels as the data traffic exceeds preset thresholds

BRI Basic rate interface; an ISDN service that consists of two 64-Kbps Bearer channels (B channels) and one 16-Kbps signaling channel (D channel) referred to as 2B+D.

Bridge A hardware device used for forwarding data between two networks. A bridge reads each packet's address information, which is written into the packet at the data-link layer of the OSI model. Unlike a router, a bridge is not interested in the address on the remote LAN but only in whether or not the packet should be forwarded

CHAP Challenge Handshake Authentication Protocol; a type of signaling authentication that uses a pair of secret codes consisting of up to 16 characters. CHAP is shared by communications devices on both ends

Dial on demand A dial-up router function that

activates a remote link only when data needs to be sent.

IETF Internet Engineering Task Force; the primary working body developing TCP/IP standards for the Internet.

ISDN Integrated Services Digital Network; a type of digital communications service offered by telephone companies. It can carry data, voice, and video over specially conditioned telephone lines

MP Multilink PPP, the IETF standard for aggregating multiple ISDN B channels using synchronous PPP framing

NT-1 Network terminator; a connector that attaches a two-wire ISDN line to a four-wire line so that it can be connected to PCs and terminals

PAP Password Authentication Protocol; a type of authentication accomplished by sending user ID/password pairs between two devices

PPP Point-to-Point Protocol; a communications protocol for linking a PC to an internetwork (a

network of networks) using regular telephone lines

Router A hardware device that allows data to be exchanged between networks by using information contained at the network layer of the OSI model. A router has built-in intelligence that directs packets to the correct destination address

RIP Routing Information Protocol; the protocol that routers use to exchange information regarding the location of different routers on an internetwork

SAP Service Advertising Protocol; a standard NetWare broadcast sent by servers every minute to announce their services, such as file and print.

SPID Service Profile Identifier; the number, assigned by ISDN providers, that identifies each ISDN B channel to the network

Spoofing The ability of a router to respond locally to certain network requests in order to avoid the need to establish a link connection to a remote site

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or by load balancing), its use of compression algorithms, and its implementation of routing and bridging, including the use of filters and static routes.

Static routes are user-configured routes that replace Routing Information Protocol (RIP) and Service Advertisement Protocol (SAP) broadcasts and are designed to cut down on WAN overhead. Dynamic routing, which is more common in higher-end routers with multiple WAN interfaces, allows packets to take different paths depending on the availability of different routes, thus increasing network reliability and performance. Our results showed that Ascend's Pipeline 50 and Combinet's Everywhere had the best overall performance.

Management is a crucial element in wide area networking and cannot be overemphasized. The ability to filter unwanted protocols and RIP and SAP broadcasts not only improves performance but also lowers monthly telco bills. We looked at how line status and user connections were monitored. We also examined security features, diagnostic tools, and system logs, as well as the ability of each router to bring individual B channels up and down according to preset data-traffic thresholds. The Everywhere and the DirectRoute led the group in this area.

Interoperability has been perhaps the biggest pitfall for ISDN and its associated products. The lack of open standards for compression algorithms, IP and IPX control protocols, and other WAN protocols usually requires using a single ISDN vendor's products at both ends of the link—

Combinet Everywhere 2060-RO

In addition to being the only product here to complete our interoperability tests successfully, the

Combinet Everywhere 2060-RO offers the most attractive mix of features, including excellent management and security. The 2060-RO also has the most flexibility built in for configuring IP and IPX routing and bridging. Network managers can choose any combination for users by defining user profiles. Protocol filtering is another of its impressive features.

Although performance and interoperability were among the factors we looked at, neither was the driving force in naming our Editors' Choice. The

routers from Ascend, Combinet, and Symplex were similar performers, and our interoperability tests were based on a developing standard. It was rather Combinet's combination of key features that made the difference.

Thus, the Ascend and Symplex routers were not far behind. Symplex won the simplicity contest but did not have the management. Ascend had the best price/performance ratio, but its lack of IPX routing was a major shortcoming.



hardly optimal for market growth.

Enter Multilink PPP (MP). MP is an open standard that defines channel aggregation across multiple B channels. Products that comply with MP can interoperate with each other. And although MP does not address other issues, such as data compression, we feel it is an important feature and one that users looking for ISDN routers should consider an absolute check-off item.

Be sure to ask the vendors about MP support and the results of their own compatibility testing with products from other ISDN vendors. In our review, we found

Ascend and Combinet to be ahead of the game in this area. Symplex was planning to add MP to its router by the time you read this. Telebit's product does not support MP, although the company says it will support this interoperability in future products.

ISDN routers make great sense for branch- and home-to-LAN, LAN-to-LAN, and Internet connections that are not required to be up all the time. Have no doubt about it: ISDN routers will replace their analog counterparts and in some cases the expensive digital leased-line routers many companies are tied to today. It's about time.

Suitability to Task: ISDN Routers

Many businesses depend on wide-area connectivity of some kind to perform vital daily transactions. Analog dial-up routers have traditionally been used in some businesses to make the wide-area connection, but ISDN is clearly becoming the WAN technology of choice for those businesses.

Yet widespread adoption of ISDN presents a challenge to the network administrator. Features unique to the technology mean that ISDN routers require a different approach for installation and management than their analog counterparts. Our Suitability to Task ratings will help you determine which of the products reviewed fill the bill for your ISDN-connected sites.

Installation and configuration are particularly important to this product set. We look for an intuitive script to walk users through installation. We consider a menu-driven interface better than a command-line interface, and we credit any process automation for enhancing ease of use. Transparent routing and bridging and auto-detection features (for the type of Ethernet connection in use or for IPX and IP addresses) are also commended features.

SUITABILITY TO TASK

Product Name

Installation and configuration	Fair
File transfer	Good
Management	Good
Interoperability	Fair

We also assess the routers' performance. We test **file-transfer** capabilities in several areas, including speed, IPX and IP protocol handling, channel BONDing, and compression algorithm implementa-

tion. Dial-on-demand features are applicable here, as are automatic link establishment and tear-down capabilities. Filtering and static routing, important criteria for reducing WAN overhead, are also pertinent

Management is one of the most crucial elements in wide area networking. We assess a router's ability to establish, maintain, and tear down an ISDN link. We again look at the router's dial-on-demand and automatic link features, focusing our attention on user-defined thresholds and controls. The ability to learn Ethernet addresses and to filter Routing Information Protocol (RIP) and Service Advertisement Protocol (SAP) are evaluated, as are the spoofing capabilities. We also pay attention to how users interface with the router—whether by a serial-port connection, via a telnet utility, or from an SNMP device.

Interoperability is a key issue with ISDN routers. We look at each router's implementation of Multilink PPP (MP), examining whether the router can complete an ISDN call and security authentication to a Network Express NE LINK-5000 with MP-compatible software. The ability to execute IP applications such as telnet and FTP is also evaluated.

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Ascend Communications Inc.

Pipeline 50

ALL REVIEWS

BY SHAWN F. KAFIPOUR

If price is a big issue or if you plan to use your ISDN router for Internet connectivity, the Pipeline 50 is a good choice. But if you're looking for ease of use or excellent operability with NetWare networks, consider another product: This version has a tough interface, and it doesn't route IPX.

Of the routers we looked at, the Pipeline 50 is not the easiest to use. The documentation is good, but the user interface has some strange menus and cryptic commands. As we became familiar with the commands and menus during testing, though, we

found that filtering options and static routes were fairly easy to configure. Even so, some functions require extensive familiarity with routing concepts.

Management features were plentiful but not particularly intuitive. Ascend's terminal server mode is a command line interface with capabilities similar to standard terminal servers such as telnet. We used it to configure a remote router while we were connected to a local Pipeline 50 through the serial port. You can also use the terminal server mode to perform simple diagnostics.

Managers concerned about security have several options. You can program the router to remember the list of IP networks and authorized users. It also features callback.

SUITABILITY TO TASK

Pipeline 50

Installation and configuration	Fair
File transfer	Good
Management	Good
Interoperability	Good

The Pipeline 50, which has a built-in NT-1 and UTP and AUI connectors, proved to be a solid performer. The bandwidth-on-demand and automatic link setup and tear-down features worked well. When you dial up another Pipeline 50, Ascend's software—which uses a proprietary protocol—can detect and utilize both B channels. On our interoperability tests, however, we could utilize only a single B channel when we connected the Pipeline 50 to the InterHub NE-5000 configured with MP. This may have been because the configuration routine lets you enter only one number for the remote device.

Significantly, the Pipeline 50 completed IP file transfers faster than any other routers

BENCHMARK TESTS

ISDN Routers



Our testing focused on performance and interoperability. Several factors can impact performance. Some routers use IP and IPX header compression, which takes advantage of the repeated network addresses in different packets. Compression algorithms also vary from one ISDN router to the next. The ability to add the second B channel (bandwidth on demand) effectively is also a factor.

In addition, router compression works differently for IP and for IPX. As a result, different routers excelled on different performance tests. Combinet's Everware 2060 was the fastest on IPX file transfers, while Ascend's Pipeline 50 finished

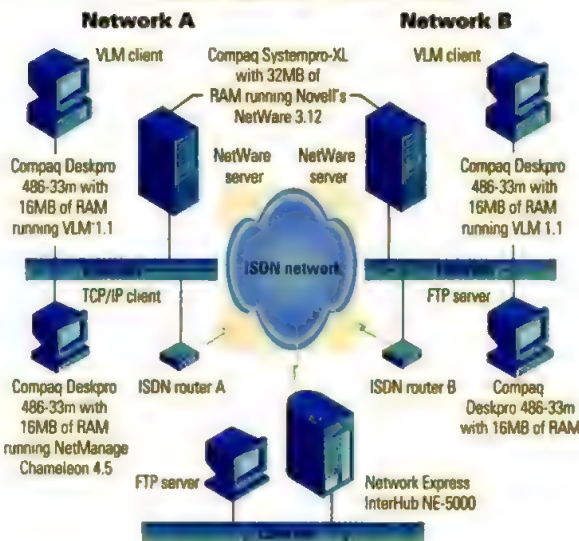
first on IP file transfers.

We also tested IP applications such as FTP and telnet. Of the four products, only the Pipeline 50 and Everware 2060 successfully completed their ISDN calls to the Network Express hub. Combinet's was the only router here to use both B channels successfully to make a connection to the NE hub.

How We Tested

We created two networks and used the ISDN routers to connect them over a BRI ISDN service. Both were set up with a NetWare 3.12 file server and two client PCs. On each network, one PC was a NetWare client running VLM 1.1 drivers to take advantage of NetWare's burst mode. The other PC was configured with

ISDN Router Test-Bed



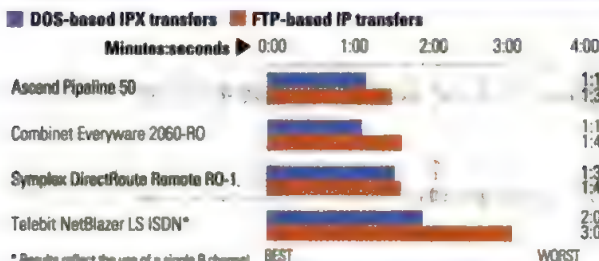
NetManage's Chameleon 4.5 TCP/IP stack.

We ran two classes of unidirectional file transfers: DOS-based IPX file transfers and FTP-based IP file transfers. We used files ranging from highly compressible to non-compressible. For DOS-based transfers, we sent our test files from the NetWare server on network A to the VLM NetWare client on network B. For FTP-based transfers, we transferred the files from the Chameleon PC on network A to the FTP server on network

B. We measured the time required to transfer all the files. We repeated the tests several times to confirm the results.

For our interoperability tests, we connected the routers to a Network Express InterHub NE-5000, which is fully compliant with MP. We tested each product's ability to complete an ISDN call, to perform PAP and CHAP authentication, and to utilize both B channels successfully. —Analysis written by Shawn F. Kafiour

TEST RESULTS



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in the field. Given this—and the fact that Ascend routers are the most common at Internet Service Provider sites—it makes sense to use the Pipeline 50 for Internet access.

On the other hand, it became apparent during testing that the product could not route IPX packets. A call to Ascend confirmed our findings: The Pipeline 50 depends on bridging to transfer all protocols other than IP, including IPX. The company says that the next revision of the software—due out by the time you read this—will include IPX routing.

That's good news, as bridging IPX imposes a serious shortcoming, especially if you run multiple NetWare servers. To its credit, though, the Pipeline 50 finished a close second to the Combinet router on our IPX transfer test, even with its dependence on bridging.

The Pipeline 50 was the least expensive product and the clear leader in IP transfer performance.

Pipeline 50. List price: \$995. Ascend Communications Inc., Alameda, CA; 510-769-6001; e-mail, info@ascend.com.

Circle 954 on reader service card

Combinet Inc.

Everyware 2060-RO



Don't judge this router by its cover. The Everyware 2060-RO (for *remote office*), one of several ISDN multiprotocol routers in Combinet's Everyware 2000 line, is not impressive at first glance. But beyond a few flaws, this modem-size router shines.

Like Ascend's Pipeline 50 package, the Combinet software suffers from a cryptic command line interface. On the other hand—and more important—the 2060-RO offers the most comprehensive management features of the bunch, and it performed well in our testing. Moreover, the 2060-RO can route or bridge IP and IPX while concurrently bridging all other protocols. It houses a built-in NT-1, as well as UTP and BNC Ethernet connectors, and it's got one of the best front-panel LEDs.

The 2060-RO's management includes support for static routing and various filtering options. During testing, it was easy to filter out RIP and SAP broadcasts. We also successfully achieved bandwidth on demand (BOND) and automatic link. We configured the 2060-RO using a terminal attached to the serial port, but Combinet also lets you telnet from any other TCP/IP workstation on the LAN.

Another great feature is the ability to create and store individual user profiles in nonvolatile memory. You can create customized configurations, incorporating parameters such as filters, passwords, line time-outs, and BOND thresholds.

The software does lack support for some utilities that could ease installation. For example, we began configuring the router from a terminal attached to its serial port. When we wanted to

PING and telnet to our FTP server, the 2060-RO's lack of support for those functions in out-of-band management required us to move to a PC running the NetManage

SUITABILITY TO TASK

Everyware 2060-RO

Installation and configuration	Fair
File transfer	Good
Management	Good
Interoperability	Good

Working Together Using ISDN

The PC world thrives only in open atmospheres and simply doesn't embrace closed ones. ISDN is a case in point. Although this technology has come a long way since its introduction, obstacles to its widespread implementation remain. One big obstacle is the lack of interoperability between different vendors' ISDN products.

The principal culprit is a lack of established protocol standards. ISDN routers typically follow the rules in the Point-to-Point Protocol (PPP), which describes the packaging of local network traffic for transmission across the wide-area link. Yet, although PPP is a published standard, companies implement portions of the standard in different and sometimes incompatible ways. For example, neither the IP Control Protocol (IPCP) nor IPX Control Protocol (IPXCP) are open standards, yet both are used to route IP and IPX protocols.

The Internet Engineering Task Force (IETF) has been attempting to establish standard control protocols to settle these interoperability issues. But it has faced resistance. Take the battle over Compression Control Protocol (CCP). Once established, CCP will let users take advantage of compression over ISDN lines even if the equipment at each end of the link comes from different vendors. But because the latest CCP proposal was halted by patent infringement threats from Motorola, ISDN vendors will continue using proprietary compression methods such as the STAC algorithm and derivatives of

V.42bis. Seamless interoperability will remain impossible.

But the battle for standards isn't entirely a losing one. Another important control protocol in ISDN is channel aggregation. This technology, often called *BONDing*, allows more than one B channel to be used for a single connection. Using both B channels can yield throughput up to 128 Kbps uncompressed.

Vendors currently depend on a number of methods for aggregating B channels. Fortunately, a standard is beginning to emerge: the IETF's RFC 1717, more commonly referred to as Multilink PPP (MP). As long as the routers on either end of a link support MP, you should be able to use both B channels. All of the ISDN vendors in this review have implemented or are planning to implement MP in their products.

But widespread MP adoption is no panacea (even though it's a good deal). MP does not address all performance issues: You'll still have to use similar devices at each end of your LAN to take full advantage of compression algorithms. And most vendors will continue to make their proprietary protocols available. If interoperability is your primary goal, you'll appreciate that MP lets you connect to dissimilar routers that are situated on remote LANs or even on an Internet Service

Provider site. You'll forfeit only a few Kbps (most Internet traffic is already compressed).

As long as vendors continue to develop open standards—and ISDN users keep up the push for widespread adoption—interoperability may be just around the corner.—SFK

■ = YES □ = NO

	Completes an ISDN call	Completes authentication	Channel aggregation	IP compatibility
Ascend Pipeline 50	■	■	□	■
Combinet Everyware 2060-RO	■	■	■	■
Symplex DirectRoute Remote RO-1	N/A	N/A	N/A	N/A
Telebit NetBlazer LS ISDN	N/A	N/A	N/A	N/A

N/A—Not applicable: The reviewed version of the product does not offer this kind of function.



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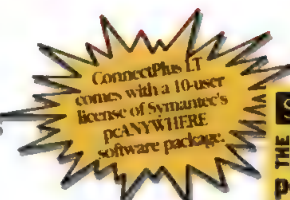
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Chameleon TCP/IP stack. Combinet says its next version will include out-of-band management tools for PING but not telnet.

Also, if we wanted to enable Combinet's CPP proprietary protocol—which adds compression capabilities beyond PPP—we had to assign IP addresses and IPX network numbers for both the LAN and WAN interfaces. If you can do without CPP, you can bypass all that.

Combinet's MP implementation was the only one that delivered what the developing MP standard promises. We successfully linked with other MP routers using both B channels. Even with its subpar interface and higher price tag, we recommend the Everywhere 2060-RO as a complete ISDN remote-office package.

Everywhere 2060-RO. List price: \$1,699. Combinet Inc., Sunnyvale, CA; 408-522-9020; e-mail, sales@combinet.com.

Circle 951 on reader service card

Symplex Communications Inc.

DirectRoute Remote RO-1

Of the four ISDN routers we tested, Symplex Communications' DirectRoute Remote RO-1 was by far the simplest to install, configure, and use. It's the only product to offer a *useful* menu-driven interface, an intuitive setup, and well-written documentation. We tested the model with a U-interface, which has a built-in NT-1 for direct connection to the ISDN line and provides UTP or AUI connectors for connecting to an Ethernet LAN.

The DirectRoute is not the most feature-rich product here, but its ease of use makes up for many of its shortcomings. We installed and configured it in under 30 minutes—a feat we could not repeat with the

other products. We used a terminal connected to the router's asynch port. Users should store the serial cable Symplex provides in a safe place, since it is proprietary.

If you run into problems with ISDN installation, call Symplex's Telco Liaison Team—which assisted us in troubleshooting an incorrect SPID assigned to one of our ISDN lines.

But simplicity comes at a price. You don't get the same level of management and control features you'll find in the other products. For example, no PING or telnet utilities are available in the router's out-of-band management (we were able to telnet to the DirectRoute using a TCP/IP workstation on the LAN).

In addition, the DirectRoute cannot be configured with static routes—a problem for shops that look for every bit of throughput

SUITABILITY TO TASK

DirectRoute Remote Ro-1

Installation and configuration	Excellent
File transfer	Fair
Management	Fair
Interoperability	Poor

Installation Challenges Relenting

It's getting easier all the time to have ISDN lines installed. The local telcos have cleaned up their order processing and their ISDN technicians are farther along the learning curve. Most vendors now provide instructions for ordering that will carry you through the process.

In fact, teams at Symplex assist users in several capacities. They help troubleshoot lines and also supply ISDN service providers with setup information. These teams can solve knotty problems—but you'll still have to take the initial steps.

The first step in ordering is to determine whether you need an NT-1 to convert from the telephone company's two-wire service drop—called a U-interface—to the four-wire connections used inside many products. You don't need an NT-1 if you're getting ISDN from your company's PBX telephone exchange or if your ISDN device has an NT-1 built in. If you do need the NT-1, you can get it from the telephone company or from telephone supply houses for about \$200.

In case you're not getting ISDN from your company, the telephone book usually carries listings for commercial services from other providers. Whichever your provider is, make sure it handles ISDN as a commercial service—as most telcos do—since some states apply tariffs to nonbusiness ISDN. Once you establish that ISDN is available in your area, the next step is to ask what type of telephone switch your local company will use to provide the service. The choices usually will be the AT&T 5ESS, the Northern Telecom DMS-100, and the National ISDN 1 (NI-1). This information will be important to you as you configure your ISDN line. In turn, the telephone company will need certain information about your router, such as its circuit type and terminal type. This information is called *provisioning*.

At some point during installation, you'll be given one or two phone numbers for your two B channels. AT&T 5ESS switches typically use one number for both channels while the other switches assign a separate number to each. You'll

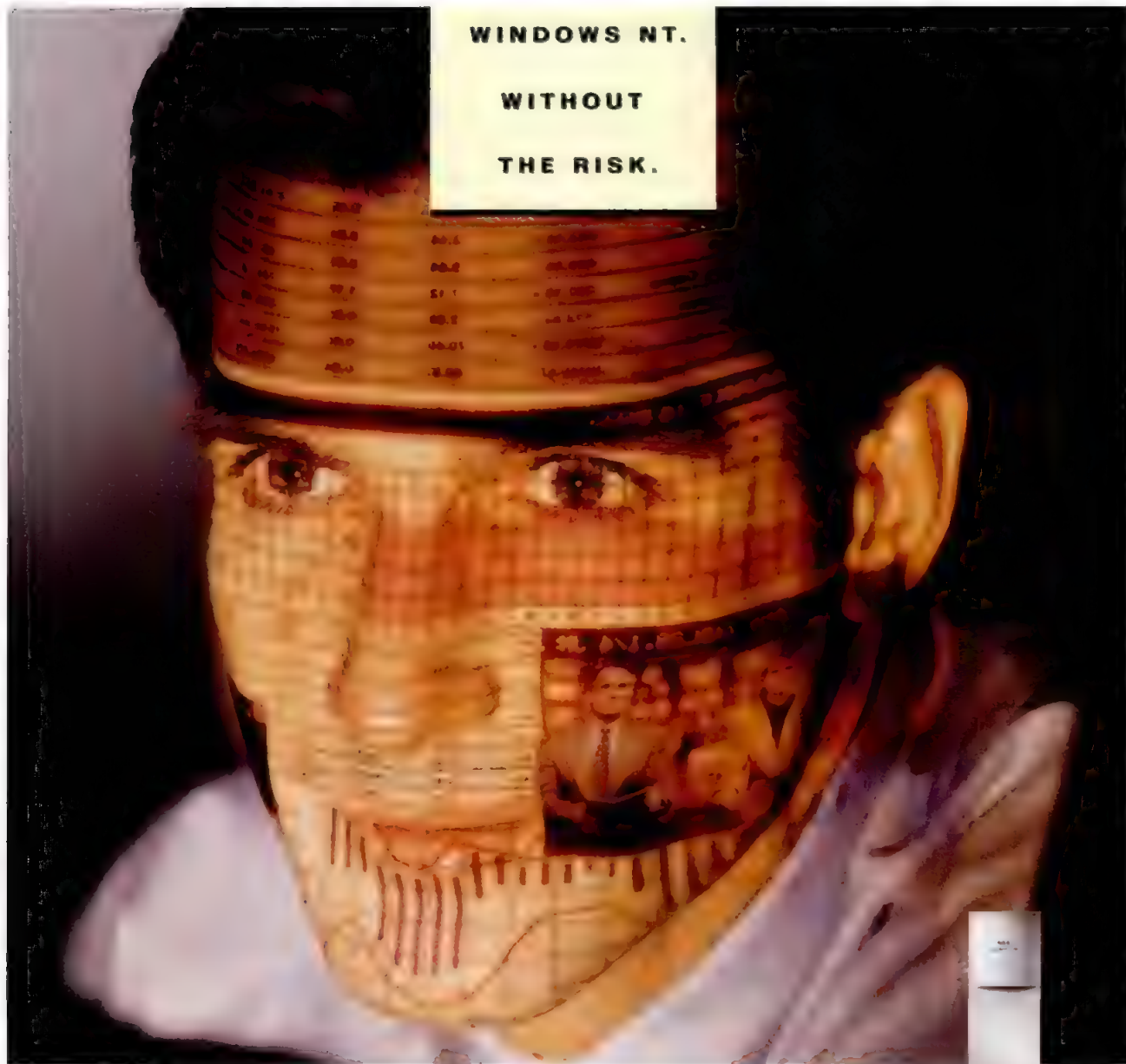
understand the phone numbers, but you might be confused over another set of numbers called the Service Profile ID or SPID (rhymes with *lid*). The SPID is the phone number with one or two numbers added to the beginning or end. You should record the SPIDs in a safe place for future reference.

Try to be present when the phone company brings in the line. The installer should run a bit-error-rate test to confirm that everything is running smoothly between the wall jack and the telephone switch. After the service is in, you can configure your device. Enter phone numbers and associated SPIDs, the switch type, and the destination's phone number; then plug the cable that's supplied with the ISDN device into the wall jack. If your ISDN device does not have a built-in NT-1, plug it into the S/T port on an external NT-1, and then run a cable from the U port on the NT-1 to the wall jack. One well-kept secret is that the NT-1's S/T interface has a distance limitation of about 1,000 feet.

A problem can arise if the effective clear-channel bandwidth is less than what you have configured for your device. A 64-Kbps clear channel provides the optimum performance; in some areas, however, only a 56-Kbps clear channel is available. Even though your local telco may provide a 64-Kbps pipe, you need to make sure that the entire route to your destination is 64 Kbps, since many telcos still use old equipment that can provide only 56 Kbps. If you're set for 64 Kbps and your connection fails, set your device for 56 Kbps and try again. Some products (such as Symplex's DirectRoute) can auto-detect the effective clear channel.

Most ISDN products have the ability to call themselves by calling out on one B channel and calling in on the other. This is a critical check of the system. Some devices have additional diagnostic utilities. If the system doesn't work, then the devil is in the details. Check every entry and cable. The equipment vendor will probably be more helpful in checking for problems than your local telco.—SFK

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they can get. Finally, the DirectRoute took slightly longer to complete its IPX and IP file transfers than the other products reviewed.

On the upside, we were able to establish and tear down the link automatically, and the bandwidth-on-demand feature worked flawlessly. Filtering is available at the MAC-address, packet-type, and protocol levels. In addition, the DirectRoute software offers a useful diagnostic menu for testing the ISDN lines. During the testing process, the program produces a log with both text and error codes to warn you of possible problems.

Unfortunately, the software that came with the router we tested did not support MP. A new version that supports MP should be available by the time you read this.

If ease of use is your primary concern and you don't need extensive management control, the DirectRoute is an excellent choice. **DirectRoute Remote RO-1.** List price: \$1,399. Symplex Communications Inc., Ann Arbor, MI; 313-995-1555; e-mail, sales@symplex.com.

Circle 952 on reader service card

Telebit Corp.

NetBlazer LS ISDN

An outdated feature set leaves us unable to recommend the NetBlazer LS ISDN unless routing AppleTalk is a singular priority for your sites. It is the only product in our review that does not offer bridging, although it is also the only product here to route AppleTalk in addition to IP and IPX.

While the NetBlazer LS has a basic menu-driven interface, many of its useful management features—including out-of-band telnet—are accessible only through a nonintuitive command line interface. The NetBlazer LS has the largest footprint of the products we tested. It also requires an external NT-1—which raises the cost by about \$200, adds extra hardware and more messy cables to already crowded wiring closets and racks, and adds one more layer of variables to trou-

bleshooting. Like the other routers we reviewed, the NetBlazer LS comes with both UTP and BNC Ethernet connections.

During our extensive testing, setting up the NetBlazer LS was torturous. We were unable to configure the routers to communicate using both B channels. Several hours of discussion with Telebit tech support didn't help, even after we allowed the support staff to log on remotely and examine our configuration. Thus, although the NetBlazer LS finished IP and IPX file transfers, it did so using a single B channel. Needless to say, we were not able to test the BOND feature.

We did, however, finally find the source of our problems: The NetBlazer LS uses load balancing to aggregate B channels. With load balancing, BOND is not set by default; the network manager must complete an additional configuration routine to assure that each B channel knows that the other exists. This additional routine is extremely complicated, stumping even Telebit's own experts.

We also couldn't perform our interoperability tests with the NetBlazer LS, as it does not support the Multilink PPP standard. Telebit says it will include MP in later releases.

Still, the NetBlazer LS does offer some unique features. Its in-band and out-of-band management support for PING and telnet applications was a lifesaver in the midst of our ongoing troubleshooting. The router has an RS-232 port that handles both synchronous and asynchronous transmissions and can therefore be used for out-of-band management or frame-relay connectivity. The NetBlazer LS also has a complete set of front-panel LEDs.

Telebit allows for detailed filtering options and static routes. It offers excellent security features, including user passwords, callback, and a DES-based cryptographic handshake.

Overall, however, the NetBlazer LS is not ready for prime time—unless routing to Macintosh networks is your highest priority. To challenge the competition seriously, Telebit needs to address the NetBlazer LS's problematic BOND capabilities and expand the functionality in the menu-driven portion of its interface.

NetBlazer LS ISDN. List price: \$1,399. Telebit Corp., Chelmsford, MA; 508-441-2181; e-mail, info@telebit.com.

Circle 953 on reader service card

Connecting to the Internet

Talk about a match made in heaven! As the Internet and ISDN have exploded in popularity, more and more Internet Service Providers (ISPs) have ISDN routers on their sites. Thus, their users who also have invested in ISDN can enjoy faster data-transfer services for their Internet connections.

This marriage should prove fruitful. Anybody who has surfed the Internet with a 14.4—or even a 28.8—Kbps modem will appreciate the performance boost once they link up through ISDN. Furthermore, since ISDN routers can connect to a LAN, they allow multiple users on your network to access the Internet simultaneously via a single WAN connection. And if you take advantage of dial-on-demand, your ISDN link will shut down when no one is surfing, and telco charges will stop accumulating.

You should try to install the same routing equipment your ISP uses. Because ISDN vendors still use proprietary compression algorithms, the only way to ensure compression compatibility is to use same-vendor devices at both ends of the link. (Ascend's Pipeline series seems to be a popular choice among ISPs, but you should check first.) Still, as long as the ISDN router at your ISP's site supports MP, you can use a dissimilar ISDN router to exploit both B channels of the ISDN BRI—provided your router supports MP as well.

For optimal performance, order Internet service over both B channels. Most ISPs that offer ISDN service offer it in increments of 64 Kbps (one B channel). Service that uses both B channels increases throughput to 128 Kbps uncompressed. Your ISP will charge more for the extra bandwidth, but you'll probably still save money, as you'll now download those cool graphics twice as fast.

Keep in mind, though, that you'll need to check with your local telco to make sure you have access to a 64-Kbps clear channel. Some ISDN providers still use 56-Kbps connections on their older switch hardware. Configuring your ISDN routers for 64 Kbps on a 56-Kbps connection may cause unpredictable link failures.

In certain cases, another type of connection (other than ISDN) might better suit your needs. If you plan to publish on-line, keeping a Web server connected to the Internet at all times, you may decide on a leased line. Because billing rates vary from region to region, you'll need to ask your ISP and telco about their ISDN connect time charges. Then you can choose the most cost-effective option.—SFK

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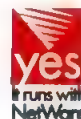
It's definitely worth noting! New Palindrome™ Backup Director 4.0 is the best backup software for Novell NetWare 4.1 servers. Complete compatibility, including native NDS, SMS and SIDS support, makes it easy to protect your entire network. And forget about the learning curve — the new Windows Control Console interface lets you effortlessly accomplish tasks with a few simple mouse clicks. Add to that, proactive alerting and error-correction systems, and speeds of up to 42 Gb/hour, and you've got the fastest, most reliable system available.

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First Looks

HANDS-ON REVIEWS OF NEW SHIPPING PRODUCTS

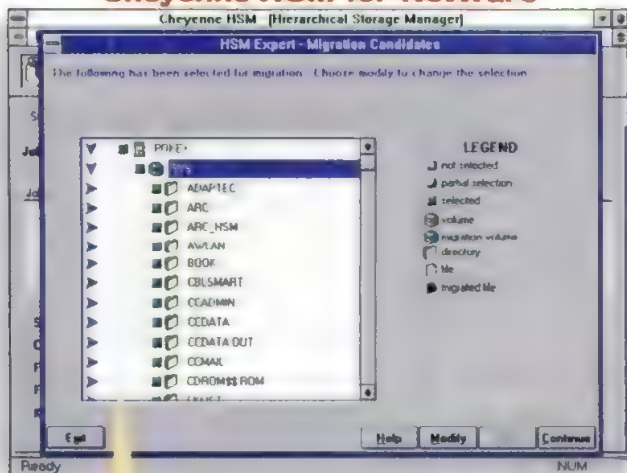
NETWORK STORAGE

HSM from Two Backup Big Shots

By Steve Rigney

Sometimes backups just aren't enough to keep your data under control. If you have a large network on which the files seem to multiply at alarming rates, you've probably given some thought to a Hierarchical Storage Management (HSM) solution. In this story, we look at two new HSM packages from two of the biggest names in the network backup market, Palindrome Storage Manager 4.0 and Cheyenne HSM for NetWare 1.0. While both products are very impressive, we found it hard to see past the immense difference in price between the two: Cheyenne HSM—without a backup utility—costs roughly six times as much as Storage Manager, which includes full backup capabilities.

Cheyenne HSM for NetWare



EXPERT OPINION: Cheyenne's HSM Expert lets you select servers, volumes, and directories for migration

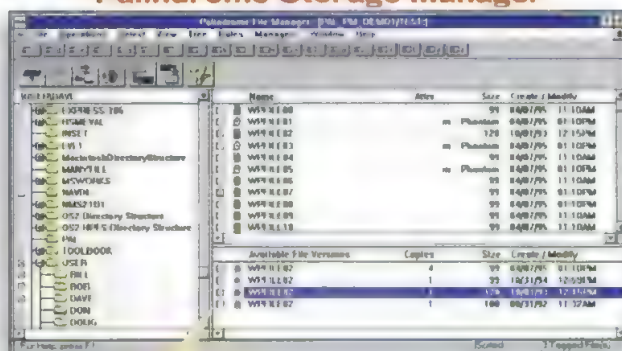
Palindrome Corp.

Palindrome Storage Manager

For only \$995, Palindrome Storage Manager 4.0, combines network backup and archival and HSM capabilities to provide a total storage management solution in one neat little package. Storage Manager also offers an easy-to-use Windows interface, excellent alert notification features, and flexible data management options.

Unlike Cheyenne HSM for NetWare (see below), Storage Manager includes backup as an integral part of the HSM process. In fact, Storage Manager will not have a file or sub-directory migrate until it has been backed up at least *three* times. This guarantees that you will have several copies of your files at any one time.

Palindrome Storage Manager



FULL VIEW: With Palindrome Storage Manager, users can retrieve migrated files and see how many versions of a file exist.

Storage Manager allows you to use any combination of storage devices in any order—but unlike Cheyenne HSM, all of these devices must be attached to the primary server. Storage Manager uses watermarks and retention rules to move files. While you would normally want files to migrate only during off-peak hours, you can configure Storage Manager so that it will perform an automatic migration if a critical watermark is reached during work hours. In such a case, Storage Manager will allow migration of only enough data to drop below the critical mark and will move the rest of the data during the regularly scheduled migration.

Like Cheyenne HSM, Storage Manager leaves a 0-byte file on the server's hard disk in the place of migrated files. The program also features a notification screen that pops-up when the user tries to access a migrated file. Unlike Cheyenne HSM, which has a DOS-only notification screen, Storage Manager provides both a 7KB DOS TSR and a Windows VxD alert utility.

Another benefit of Storage

Manager is its powerful notification and management features. In the event of a problem on the HSM server, for example, Storage Manager will automatically send an alert to the network administrator via e-mail or a NetWare broadcast message. Storage Manager also includes an SNMP agent that will send information to an SNMP management console.

One of Storage Manager's strongest features is file staging, through which it takes files that meet the migration criteria and copies them to the proper HSM tier—whether or not your server has reached a watermark. When you reach a watermark, Storage Manager automatically replaces the prestaged files with a marker. This prevents your server from running out of disk space and performing a traffic-intensive migration during work hours.

All in all, Storage Manager is a complete backup and data management solution. Best of all, it's a bargain.

Palindrome Storage Manager 4.0. List price, \$995. Palindrome Corp., Naperville, IL; 800-288-4912; fax, 708-505-7917.

Circle 956 on reader service card

First Looks

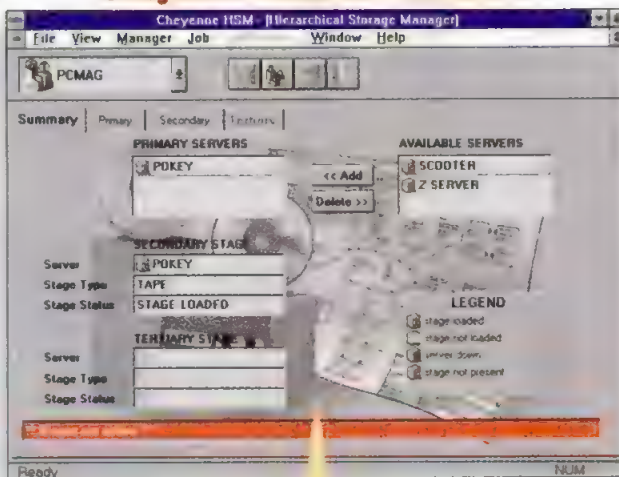
Cheyenne Software Inc.

Cheyenne HSM for NetWare

Cheyenne HSM for NetWare, 1.0, is extremely easy to use, offers an excellent interface and an array of reporting capabilities, and is the first product to take advantage of the HSM services built into NetWare 4.x. The package also works closely with Cheyenne's backup utility ARCserve for NetWare.

Unfortunately, at \$6,995 Cheyenne's product is one of the most expensive HSM solutions on the market. Unlike Palindrome Storage Manager, Cheyenne HSM does not include any network backup software. Although you don't need a backup utility to run Cheyenne HSM, we don't imagine there are too many folks who will set up an HSM system without setting up a backup system as well. With prices ranging from \$395 to \$9,995, Cheyenne's ARCserve for NetWare will add a significant amount to your HSM system price. For existing ARCserve users unconcerned with price, however, Cheyenne HSM has a lot to offer.

Cheyenne HSM for NetWare



QUICK UPDATE: Cheyenne HSM for NetWare lets you quickly check the status of your HSM servers and storage devices.

Like most other HSM products, Cheyenne HSM uses a combination of watermarks and retention rules to cause files to migrate. The watermarks are based on the amount of server hard disk space remaining and are divided into three levels: low, high, and critical. Once a watermark is reached or exceeded, Cheyenne HSM will start moving data according to the retention rules, which delineate file types

that should not be moved (such as executables and system files).

With Cheyenne HSM, you can use a single storage device for migration or set up several storage tiers. For example, your first tier might be an optical jukebox, while your second tier might be a slower 4-mm DAT drive. You can attach these storage devices either to one server or to various servers across your network.

When Cheyenne HSM causes a file to migrate, it places a 0-byte *stub* file on the server's hard disk to represent the missing data. Users won't know a file has migrated unless they try to access it at which time a 4K TSR on each client alerts them. For DOS users, the TSR will display an estimated retrieval time and provide the option to cancel the retrieval. Windows users, on the other hand, merely hear a series of beeps. We found the added value for DOS clients a bit odd.

One of Cheyenne HSM's strongest features is its Windows-based utility HSM Manager. HSM Manager allows you to schedule migrations based on file type, last access date, and file attributes. You can also generate dozens of different reports based on file access and other migration statistics.

We liked Cheyenne HSM and were impressed with its many features. It's the pricing that left us wondering.

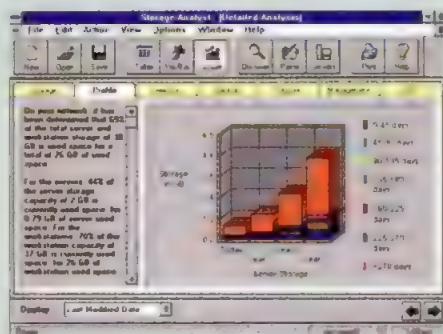
Cheyenne HSM for NetWare 1.0. List price: \$6,995. Cheyenne Software Inc., Roslyn Heights, NY; 800-243-9462; fax, 516-484-3446.

Circle 955 on reader service card

Palindrome Storage Analyst

The concept of implementing HSM on PC-based networks has been plagued with a bad reputation for years. Most network administrators claim that HSM is too expensive and too complicated, and that adding hard disks and servers as storage needs grow is cheaper. Fortunately, Palindrome Storage Analyst (\$99) can put your fears to rest and tell you whether or not HSM would save you money and even increase your network performance.

Palindrome Storage Analyst allows you to scan your network and estimate your disk requirements to build a model of your storage needs for up to three years down the road. You can also use Storage Analyst over a period of days or weeks to get a better idea of how your network users manipulate data



WHAT TO DO: Storage Analyst can help you plan your network-storage needs.

on your file servers.

Storage Analyst is an intuitive, Windows-based utility that runs on any network client. You can view your storage model through a variety of graphs and tables. After you have completed your analysis, you can save your report or print it out.

Storage Analyst provides you with a cost/benefit analysis of your storage management needs and suggests the Palindrome product that best fits those needs. Cheyenne also offers a

storage analysis tool, but it comes as part of the Cheyenne HSM package. Palindrome Storage Analyst, on the other hand, is a great tool to have on your shelf whether you're considering HSM or not.

—Steve Rigney

TAKE CONTROL
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An underwater scene with a blue background and a small, striped fish swimming in the lower right corner. The text is arranged in a vertical sequence, centered horizontally.

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First Looks

FAST ETHERNET ADAPTERS

The PRO/100 Gets Smart

By Padraic Boyle

Intel is trying to make its EtherExpress PRO/100 PCI Fast Ethernet adapter even more impressive. The new EtherExpress PRO/100 PCI Smart adapter, intended primarily for use in high-performance application servers, features an on-board i960 processor, which off-loads CPU usage and enhances performance. At the time of this review, however, the PRO/100 Smart adapter worked only with NetWare.

The PRO/100 Smart adapter (\$895), which was codeveloped with Novell, provides Plug and Play compatibility for easy installation and configuration. Like the PRO/100, this card has a single, auto-sensing RJ-45 port that sets itself to the appro-

priate network speed.

The PRO/100 Smart is basically a full-size version of the PRO/100 with added intelligence: The i960 processor works in unison with a smart DMA-bursting chip and 2MB of RAM. To lower CPU utilization, a portion of the adapter driver and even some NetWare code run on the adapter, saving server CPU cycles and increasing performance.

Considering the high price tag of the PRO/100 Smart (by comparison, the PRO/100 costs \$259), you might ask, What am I getting for my money? Low CPU utilization, for one thing. Secondly, a noticeable performance increase. Thanks primarily to the i960, the PRO/100 Smart was able to score 88 megabits

per second on our NIC Throughput test with 16K blocks, while utilizing only 24 percent of the file server's CPU. During the tests with smaller blocks (64 bytes), however, the PRO/100 Smart did not perform quite as well. In spite of low CPU utilization, it moved data at less than 5 Mbps with four clients. The PRO/100 displayed significantly higher throughput during this test but with considerably higher CPU utilization.

During testing, we saw some unusual results. With only two clients attached to the test network during our NIC Throughput tests with 16K blocks, the PRO/100 Smart showed an unusually high CPU utilization. After speaking with Intel and Novell about these results, we were informed that the flaw was caused by the way Novell's VLM client handles high-speed adapters. Novell plans to release a fix by

the time you read this.

The PRO/100 Smart has one major drawback: a lack of drivers. Currently, the card works only with NetWare 3.x and 4.x. A mirrored server link (MSL) driver is also available for environments using NetWare SFT III. A driver for Microsoft Windows NT Server may be available by the time you read this. In contrast, Intel's PRO/100 provides drivers for all of the major NOS players including Microsoft LAN Manager, NetWare, and OS/2 LAN Server Advanced.

The PRO/100 Smart is ideal for high-performance environments, but for the time being, those environments can be running only NetWare.

EtherExpress PRO/100 PCI Smart. List price: \$895. Intel Corp., Hillsboro, OR; 800-538-3373, 503-629-7354; fax, 503-629-7000.

Circle 977 on reader service card

Continues on page NE47

BENCHMARK TESTS

Fast Ethernet Adapters



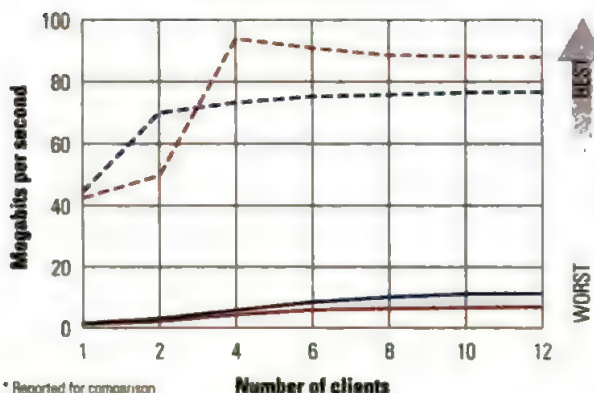
We tested the Intel EtherExpress PRO/100 Smart PCI using the NIC Throughput test from NetBench 3.0 and the CPU Utilization test, generated using Novell's STAT.NLM. We compared its performance with that of the Intel EtherExpress PRO/100 PCI. Thanks to its built-in i960, the PRO/100 Smart's throughput was high and its CPU utilization was generally low. But because of a problem with

the NetWare VLM drivers, its CPU utilization soared when we tested the product with a 16K block size and two clients. With greater client loads, however, its CPU utilization settled into a more acceptable range.

Our 12-node NetWare 3.12 test-bed included an HP NetServer LF 5/66 server with 128MB of RAM and a Grand Junction FastHub 100 repeater.

- Intel EtherExpress PRO/100 Smart PCI (64-byte blocks)
- Intel EtherExpress PRO/100 PCI (64-byte blocks)*

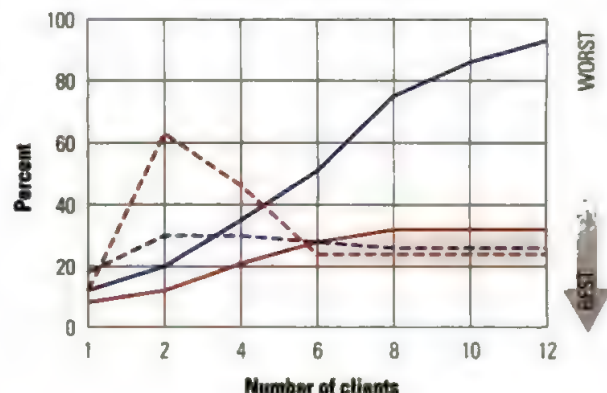
NIC THROUGHPUT



* Reported for comparison

- Intel EtherExpress PRO/100 Smart PCI (16-byte blocks)
- Intel EtherExpress PRO/100 PCI (16-byte blocks)*

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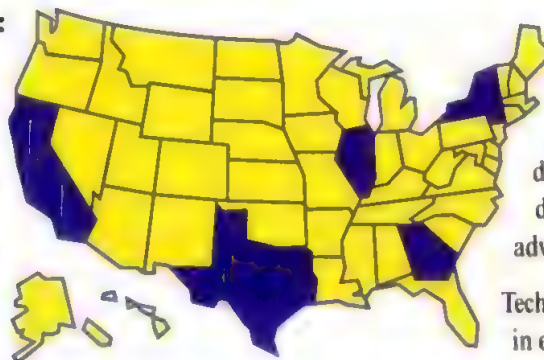
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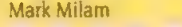
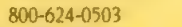
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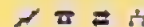
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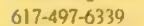
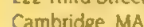
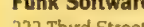
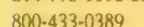
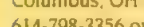
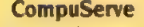
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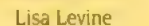
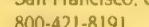
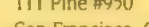
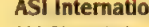
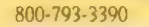
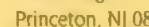
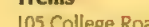
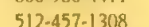
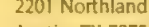
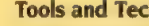
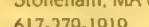
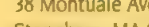
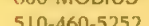
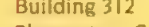
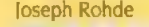
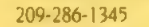
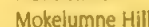
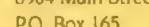
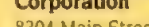
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CASE STUDY

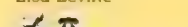
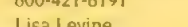
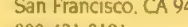
Timberland

Timberland uses Lotus Notes as the backbone of its apparel planning process to quickly consolidate, organize and disseminate design, marketing and production information worldwide. Notes has re-engineered the process, allowing the company to take all apparel lines "from concept to market". Notes is also used as a data analysis tool allowing Timberland to do complete analysis of inventory, production balances, even to track the most popular colors. With Notes, the field and international operations feel more tied to the home office and the apparel planning process. Notes keeps the pace of the business moving, because management can constantly monitor the process, keep everyone updated, and make sure all the necessary information has been added.



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CASE STUDY

Mission Energy Corp.

Mission Energy Corp., a \$2.9 billion division of Southern California Edison, builds, manages and finances power facilities around the world. Mission Energy has deployed Lotus Notes to all international employees, connecting these remote locations together into one unified company. And the distant locations can act and react as a single company. "It's like 300 different brains can contribute to a discussion or work to resolve a problem at the same time." The company uses Notes for project management and planning, to manage customer and account information, to get up-to-date news and information and to keep traveling executives in touch with the home office.

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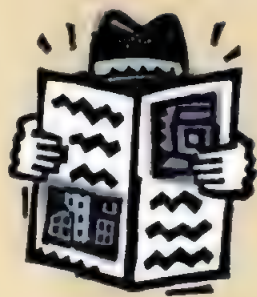
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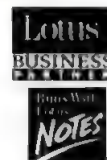
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CASE STUDY

Burger King

Burger King used Lotus Notes to re-engineer its regional operations and get back to the business of selling burgers, soft drinks and fries. Burger King created small, highly mobile, multi-disciplined regional teams of individuals. Each team consists of expertise in construction, real estate, purchasing, marketing and service. Each self-managed team is now responsible for restaurant accounting, determining credit fitness, employee relations, expansion approval and recruitment — all functions formerly handled at headquarters.

Now, using Lotus Notes, Lotus SmartSuite, and laptops, team members share their expertise daily and actionable connections are made directly between the source and the receiving point of the information. This solution supports team collaboration. It is now easier for a team to address specific problems and opportunities that arise with franchises and rapidly respond to them. According to Bob Frosell, Sr., VP of Business Transformation, "We put decision-making into the hands of the people who can make a difference. And we are winning."

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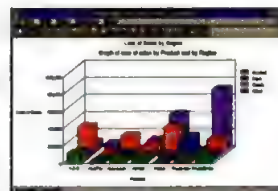
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CASE STUDY

Fireman's Fund Insurance

Fireman's Fund first used Notes during the devastating Oakland, California fires in July, 1991. The company set up a command center, and instantly developed a Notes application to track all policy holders in the area. The company had concrete information on the fire damage and loss to policy holders in just 24-48 hours — earning them a #1 customer response approval rating.

Fireman's Fund then rolled out Lotus Notes throughout the company. They use Notes to send and file automated forms and letters, to minimize paperwork, to disseminate industry news abstracts, to develop business plans, to chart quarterly progress, to plan meetings, to manage workflow, to track service levels, performance appraisals, turnover rates, salary guidelines and to handle all human resource information. The biggest advantage is that now everyone knows what is going on within the company, and know where to find any document they need. There is also a consistency of information and communications for the first time.

Virgil Pittman, Fireman's Fund CIO states, "If I could buy one and only one software product in the world, it would be Lotus Notes."

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CASE STUDY

Waters Corporation

For Waters Corporation, a leading supplier of scientific equipment, Notes support for mobile users has proven crucial. Field sales representatives use a combination of Notes and Freelance Graphics to access and deliver their latest product presentations. Salespeople can quickly review account histories and competitive information while on the road. Information that used to take days to distribute is now instantly available through Notes. Sales management has up-to-the-minute reporting so it can be more accurate in forecasting, and representatives in the field are getting leads when they're hot. The bottom line: Waters Corporation reports an R.O.I. of 300% on their investment.

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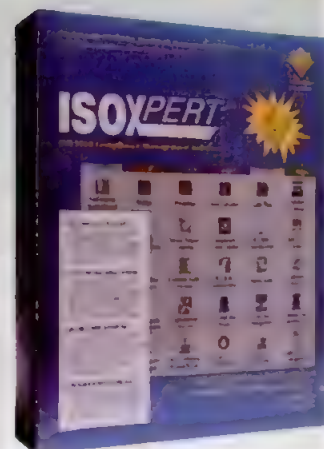
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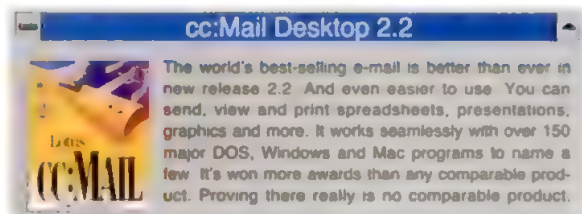
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Joe King

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CASE STUDY

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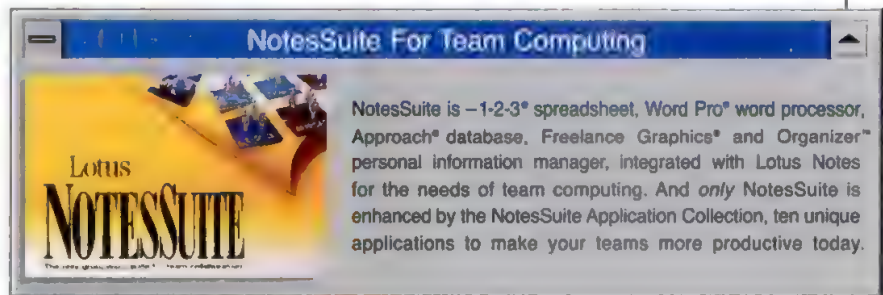
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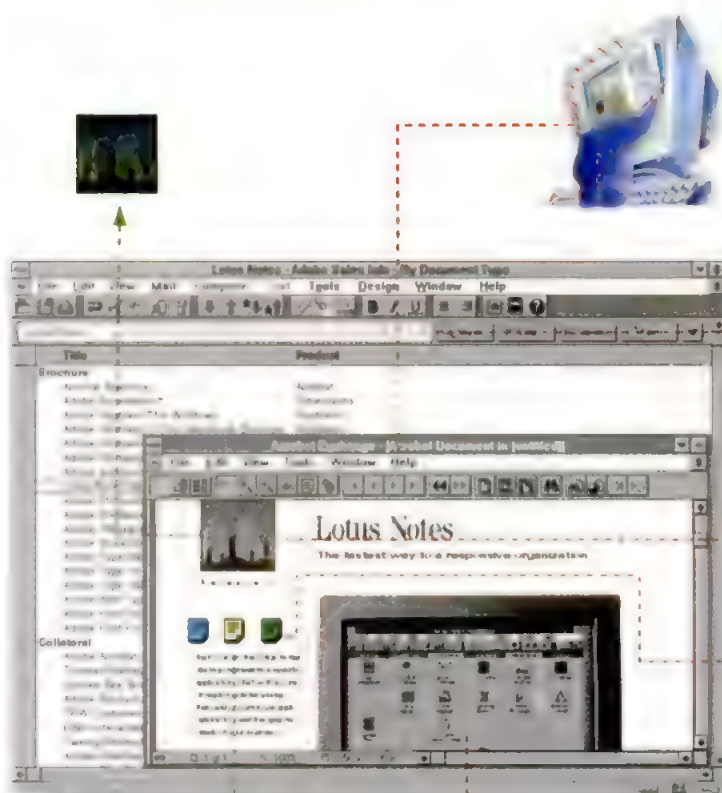
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Note 1: Label Read Mer Date
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UNIX

SCO Gets Serious with OpenServer

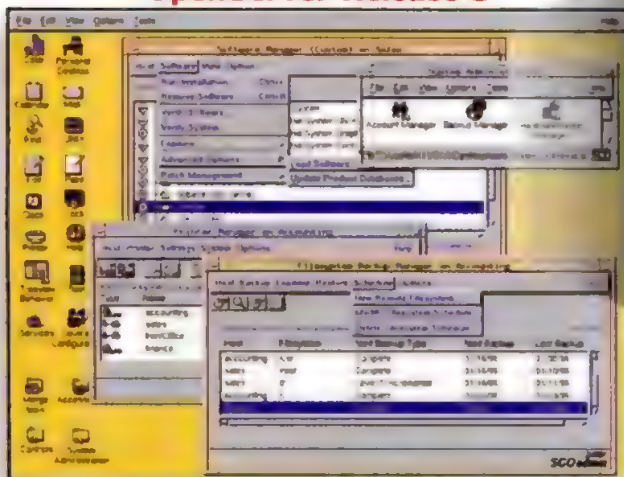
By John Garris

The Santa Cruz Operation (SCO) has completely overhauled its Intel-based Unix operating system. OpenServer Release 5 (OSR5) marks a major step beyond its predecessor, Open Desktop 3.0. OSR5's new features include a journaling file system, integrated symmetric multiprocessing (SMP) capabilities, better NetWare integration, and new graphical management tools. Aside from some installation problems, we found this to be a very impressive OS.

OSR5 is SCO's strongest ef-

positive side, most of the installation process is unattended: After you run through a set of configuration screens, the install program automatically transfers all of your files and builds your file system. OSR5 also auto-detects any PCI- and EISA-based network adapters in your machine. You can install new software over the network as well as from CD-ROM, tape, or floppy disk. One CD-ROM installation, using a Compaq Deskpro 486/33, took about 90 minutes to complete and required roughly 170MB of disk space.

OpenServer Release 5



we rebooted the machine and saw only a blank screen.

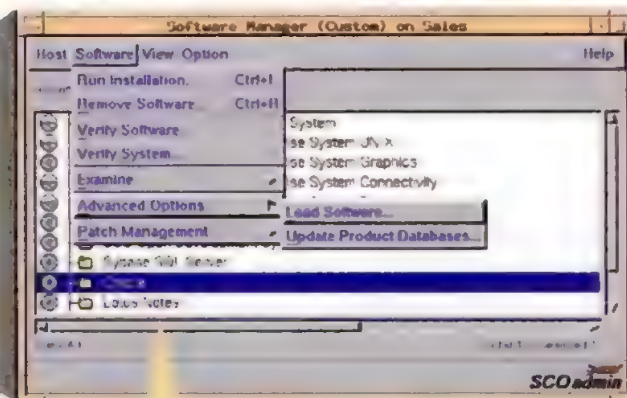
In general, if you're used to installing older SCO systems, you'll appreciate the improvements in the OSR5 installation. But OSR5 has a long way to go before it offers the installation flexibility and reliability of Windows NT or UnixWare 2.0.

Once loaded, OSR5 offers a lot of useful new features. The new graphical administration tools make it easy to manage OSR5 systems. These tools, known collectively as SCOadmin, let you add or delete users and software, manage printers, and check your network configuration with just a few mouse clicks. SCOadmin can also run

in the previous release). Journaling helps ensure file system integrity in case of power failure by logging all operations that go to hard disk. The base package also lets you retrieve previously deleted files, and it provides a hook to American Power Conversion Corp.'s uninterruptible power supplies allow for safe system shutdown.

For extra performance, you can purchase SCO SMP licenses to take advantage of extra server processors. Additional licenses cost \$995 per CPU, with a theoretical limit of thirty.

OSR5 also offers a high level of compatibility with Windows-based applications through a utility called Merge. Merge lets



FEATURE RICH: SCO's OpenServer Release 5 includes several new features, such as the ability to upload software updates over the network.

fort yet to capture the growing market of application servers. Compared with Microsoft Windows NT, Novell's UnixWare, and SunSoft's Solaris x86, OSR5 is a good choice for small to medium-size businesses that need reliable operation, good performance, and compatibility with existing line-of-business applications. With substantial inroads into horizontal markets such as retail, government, and banking, SCO boasts an extensive list of third-party apps that work in each of those areas.

During testing, we found some good and bad things in the installation procedure. On the

Our first installation attempt, using an HP Vectra 5/90, was far from successful, primarily because of hardware incompatibilities, along with some other quirks. For instance, OSR5 expected our CD-ROM drive to be set to SCSI ID 5. It wasn't; OSR5 couldn't perform the installation. We also had problems with video drivers: OSR5 assumed we had an S3-based controller found on earlier HP Vectras rather than the Matrox controller that shipped with our computer. We didn't know about the problem until an hour later (the installation is supposed to be unattended), when

in character mode, which is helpful if you're performing tasks from a remote terminal.

If you have an existing NetWare infrastructure, you'll appreciate OSR5's NetWare integration. You can mount NetWare volumes directly as OSR5 file systems to get direct access to your NetWare files using IPX. We did run into some problems when OSR5 didn't automatically detect the IPX network number or Ethernet frame type on the network, but once we fixed that we logged on without any trouble.

OSR5 includes the High Throughput File System (HTFS), which provides journaling capabilities and a 512GB file system limit (up from 2GB

you run DOS 6.21 sessions directly on the Unix system. Although it doesn't include Windows, you can install your own copy to run over Merge. SCO also offers WABI, a Windows emulation package that lets you run selected Windows programs within an X Window. Both products are sold separately, and each costs \$395 for a single user and \$995 for a full server system. **SCO Open Server Release 5.** List price: 5-user Enterprise System, \$1,295; 5-user Host System, \$695; 1-user Desktop System, \$795; 100-user license, \$2,995. The Santa Cruz Operation Inc., Santa Cruz, CA; 800-726-8649; fax, 408-458-4227; Web, <http://www.sco.com>.

Circle 985 on reader service card

ISDN

BitSurfr: Motorola Strikes Gold

By Les Freed

Motorola's BitSurfr ISDN terminal adapter is one of those rare breeds of products that promises a lot and delivers it all with élan. From the stylish contoured plastic case to the easy-to-understand configuration software, the BitSurfr (\$495) is a pleasure to install and use.

The BitSurfr is the only ISDN adapter we've seen that worked with every piece of software we threw at it—including Microsoft Windows 95's dial-up networking. As a bonus, the BitSurfr provides ISDN-to-analog conversion that lets you use your existing analog fax machine, modem, and telephone on an ISDN line.

At first glance, the BitSurfr looks just like a modem. The front of the diminutive case has six status LEDs—just like a modem. The equally modem-like rear panel contains the usual connectors for an RS-232 connection, a power cord, and two phone-line jacks. One of the jacks is an RJ-45 eight-pin ISDN U interface (no external NT-1 interface is required), and the other is a RJ-11 jack to connect your existing analog fax machine, modem, or telephone.

The BitSurfr even operates like a modem. It responds to industry-standard AT commands to provide a high level of compatibility with your existing communications software. This isn't actually as useful as it sounds, however, since you'll probably use different software for ISDN than you would for analog communications.

The BitSurfr comes with a complete suite of software in the box, including Hilgrave's HyperAccess Lite, NetManager's Internet Chameleon, and Pacific CommWare's TurboComm/2 communications drivers for Microsoft Windows 3.1.

Ordering an ISDN line from

your local phone company can be a gut-wrenching experience, filled with strange telephone company jargon. Motorola is well aware of this problem, so it provides two sets of forms that you can mail or fax to your telephone company to help ease the ordering process. The forms contain all the information that the phone company needs to configure its equipment (and your ISDN line) to work with the BitSurfr.

At your end of the ISDN line, the Windows-based Motorola Configuration Manager lets you set the BitSurfr's operating parameters quickly and easily. Some knowledge of ISDN is required on your part, but if your local phone company gives you the correct information, you should have the BitSurfr up and running in about 10 minutes. If you're installing multiple BitSurfrs, you can save the configuration pa-



SLICK SURFR:

Underneath the slick exterior lies a very impressive ISDN adapter.

rameters to a file and use the same settings for each unit.

We tested the BitSurfr with several communications applications under Microsoft Windows for Workgroups 3.11 and the final beta release of Windows 95. All of the programs worked as expected, and we even encountered a few pleasant surprises. Because the BitSurfr is compatible with Plug and Play, installation under Windows 95 was a simple matter of plugging in the serial cable and rebooting our

system. Windows 95 recognized the BitSurfr and installed the appropriate drivers. We then ran the Motorola Configuration Manager, plugged in the ISDN-line information, and were off and running.

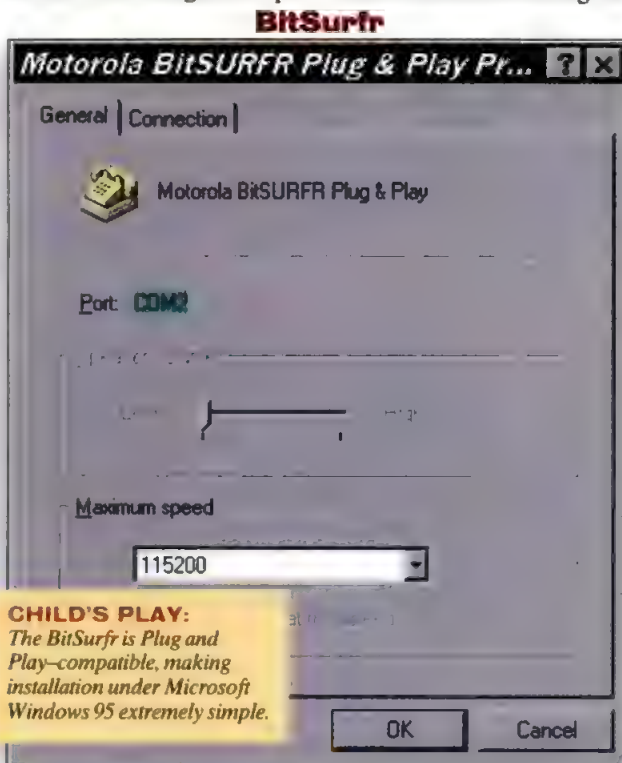
If you've ever tried to set up a dial-up connection to a TCP/IP-based Internet provider, you know what a struggle it can be. Using Windows 95 with the BitSurfr, we simply created a new connection from the Dial-Up Networking program and entered an account name, password, and local Internet access number. One click on the Connect button and we had a 64-Kbps Internet connection in a matter of seconds.

The BitSurfr doesn't have a power switch, since it is intended to serve as an ISDN-to-analog converter even when the PC is turned off. We made several voice telephone calls using an old Panasonic telephone plugged into the BitSurfr's RJ-11 jack, and everyone we called commented on how crisp and clear the audio sounded.

Simply put, the BitSurfr provides rock-solid ISDN connections at a reasonable price. The combination of Plug and Play compatibility, analog telephone support, and easy configuration makes this product an excellent choice.

BitSurfr. List price: \$495. Motorola, Huntsville, AL; 800-451-2369.

Circle 980 on reader service card



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First Looks

NETWORK ADMINISTRATION

WhereAbouts Tracks Your Users

By Steve Buehler

If you have one of those in-and-out pegboards in your office to track everyone's comings and goings, you may no longer need one. Futurus's new WhereAbouts, Version 1.0, is an inexpensive software utility that lets you see where your coworkers are throughout the day. It's simple to set up, and it provides some very useful information, but it might make a few of your colleagues paranoid.

WhereAbouts is a straightforward and user-friendly product, possibly because of the considerable experience Futurus has gained from developing its TEAM line of groupware products. Available for either DOS or Windows platforms (both versions are included in the package), WhereAbouts is easy to install. You don't have to set up NetWare or LANtastic supervisor privileges; all you need is shared space on a network volume that every WhereAbouts user can access. Setting up users is also a breeze. WhereAbouts reads the NetWare Bindery and presents a list of users for possible inclusion in the WhereAbouts directory.

The final step after this initial global setup is installing a DOS or Windows client on each user's PC. This was a trivial task, although there is no import facility that allows you to pull names from an existing list, such as a PIM.

Each user's status can be identified through several basic messages, including "In," "Out," "Lunch," and "Meeting." Also, you can add in your own special messages, such as "In Court" or "On Sales Call."

Once we got the package up and running, we immediately recognized the strengths of WhereAbouts. An in-and-out

board is only as good as the information that goes into it—if a person forgets to update the board, you might never know where that person is. Even with WhereAbouts' simple status-change mechanism—two mouse clicks, and you can change from "In" to "Lunch"—some users may forget to update their status. WhereAbouts actually watches for special events, such as computer start-up, shutdown, and some period of keyboard inactivity to help provide an indication of a user's current status. Also, WhereAbouts lets you set proxy rights so that a given user (a department administra-

tor, for example) could keep information current even when some users forget to update their own status.

IS BIG BROTHER WATCHING?

While knowing where everyone is can be important, WhereAbouts offers a few additional features that could make privacy fiends nervous. For example, if you want to be notified as soon as a user changes status, you can set a Trace on that person. So if this user returns from a meeting, a message is sent back to you, notifying you of the change. The user being traced is also informed of the request, so it's a simple way to let someone know you were looking for them.

A more powerful (and ominous) feature, Monitoring, al-

lows one user to watch quietly for changes in another user's status. The watcher can even have electronic mail sent when the status changes, but in this case the user being watched receives no notification.

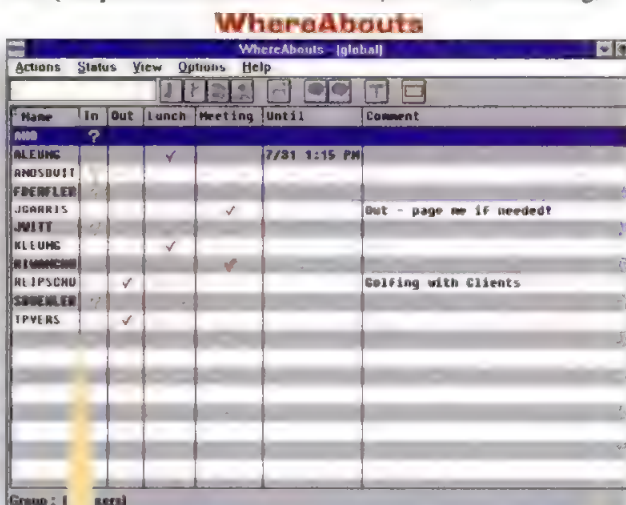
And of course, Where-Abouts provides some good reporting capabilities. You can print an activity report or prepare it for importing to a spreadsheet or database. These reports contain information such as when users started their computers, when they changed their status during the day, how long their machines were idle, and when they shut off their machines for the day. While all of this is certainly valuable information, and perhaps appropriate for some employees, such monitoring might not be met with much enthusiasm in some environments.

Still, WhereAbouts can be a valuable tool and offers several other nice touches. Users can create one-time status messages, such as "Do Not Disturb—Deep In Thought." Adding a duration time to an event like "Golfing with Clients" could show that you left the office at 11:30 but won't be back until 4:00. Personnel information, such as titles, addresses, cellular-phone numbers, and even birth dates, can be added to users' information profiles so that emergency instructions are never more than a click away.

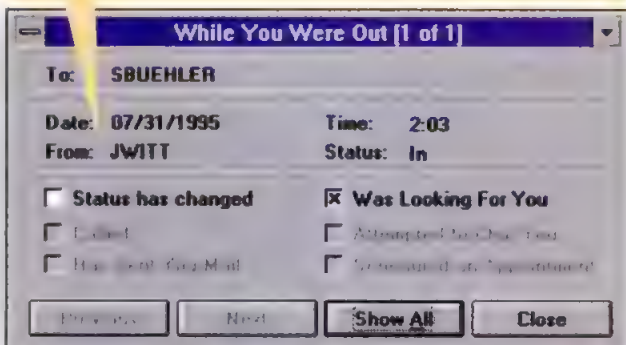
Finally, Futurus has adopted an aggressive pricing scheme for WhereAbouts. A seven-user version is freely downloadable from Futurus's World-Wide Web and FTP sites. The ten-user license is \$199, and the per-user price drops steadily as the number of users increases.

WhereAbouts, Version 1.0. List price: For ten users, \$199; for 25 users, \$299; for 50 users, \$499; for 100 users, \$799. Futurus Corp., Norcross, GA; 404-242-7797; fax, 404-242-7221; Web, <http://www.futurus.com>.

Circle 978 on reader service card



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PC MAGAZINE CIRCLE 921 ON READER SERVICE CARD

First Looks

WINDOWS NT UTILITIES

Make Windows NT More Like Unix

By Steve Rigney

Microsoft Windows NT is frequently billed as a Unix alternative, and Intergraph Corp.'s Batch Services for NT (\$250) can help the OS live up to that billing.

Most Unix sites use a process known as batch processing and load balancing to disperse CPU-intensive jobs across several networked machines. Until now, this process has been unavailable in Windows NT environments.

In the Unix world, a public-domain standard called Network Queuing System (NQS) defines batch processing to make it possible for any computer to farm out jobs such as photo digitizing, document indexing, and even straight number crunching, to other computers. NQS can also perform housekeeping jobs like initiating network backups. Many vendors, including Cray Research, Data General, Digital, IBM, Intergraph, and Sun market Unix products that take ad-

vantage of the NQS standard.

Batch Services for NT, which runs as a 32-bit system service on any Windows NT 3.x PC, brings NQS functionality to Windows NT. The package is compatible with the many programs that use NQS and it also takes advantage of the security in Windows NT to protect your processed data from intruders.

On Windows NT networks that don't have Unix resources or the need for load sharing, Batch Services is useful for scheduling jobs such as polling sales locations, compiling end-of-day accounting data, and updating files during off-hours and then sending the results to other PCs and servers at prescheduled times.

The Batch Services main menu looks much like the Print Manager utility in Windows NT. To create a job, you simply select New, give the job a name, and associate the job with an application or a script. Batch Services can execute any DOS or Windows-based

application including .EXE, .COM, and .BAT files. You can also create a Batch Services script using the Practical Extraction Report Language (PERL) Unix scripting language. Fortunately, Intergraph includes several canned scripts as examples.

Batch Services is extremely easy to install, but the menus can be a bit confusing. This is a system that you can use immediately for some useful tasks such as job scheduling, but the step from a simple job like that

to sophisticated jobs like parceling out processing tasks is huge. Unfortunately, the manual is not very thorough and we found the best way to learn the product was through trial and error.

Still, Batch Services is a good tool for making Windows NT an even stronger alternative to Unix.

Batch Services for NT, Version 1.0. List price: \$250. Intergraph Corp., Huntsville, AL. 205-730-6328; fax: 205-730-6000.

Circle 982 on reader service card

ETHERNET SWITCHES

Two Lean, Green Machines

By Padraic Boyle

PlainTree Systems' WaveSwitch 100 series Ethernet switching hubs not only enhance network performance between clients and the hub, but also offer the flexibility and expandability to integrate one of several high-speed networking technologies for the backbone.

For this review, we took a close look at the WaveSwitch 100-8 (\$6,495), which has eight 10Base-T ports, and the Wave-

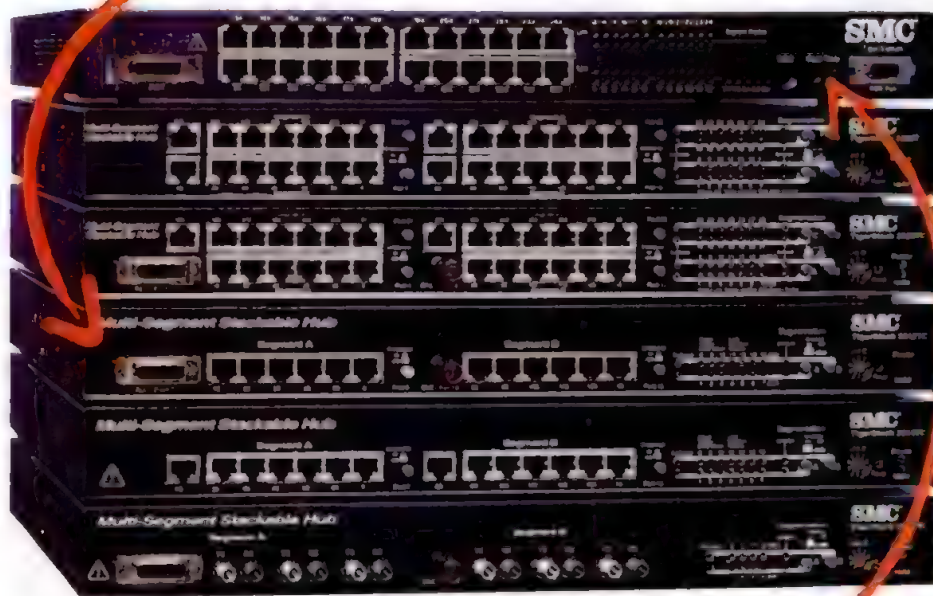
Switch 100FL (\$11,995), which has 12 fiber ports. A 16-port 10Base-T model is also available.

Both units we tested were virtually identical in terms of installation and features, and they are both good choices for enhancing a medium-size network's performance. We had no difficulty setting up either unit; we just plugged them into the network and let them go. The client ports are positioned on the front of the bright teal

Batch Services for NT

WINDOWS NT AUTOMATION: You can use Batch Services for NT to create jobs for launching script files, then schedule that job to run during off-peak hours.

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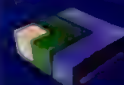
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Multiprotocol Switching

ATM, HSSI, FDDI

First Looks



chassis, as is a series of LEDs that indicate port activity and switch status. An RS-232 port

(also on the front) provides a link for optional out-of-band management.

The WaveSwitch has two expansion slots for Feature Mod-

EYE-CATCHING: The WaveSwitch 100 series switches are powerful and flexible—and they'll brighten up any server room.

ules, which provide connectivity to 100Base-TX, 100VG-AnyLAN, or FDDI high-speed LAN connections. A Feature Module is also available for PlainTree's proprietary Fast Ethernet solution, WaveBus, as well as 10Base-T, 10Base2, and 10Base5. Currently, neither of the units supports ATM.

Pricing for the Feature Modules differs between the two units because the 100-8's price includes the price of one or two Feature Modules. The 100FL, on the other hand, is

sold for the straight list price, and the Feature Modules are purchased as separate units.

Although PlainTree does not include a management software package, it does offer an SNMP agent and a MIB II extension. This allows you to use any SNMP-compliant management package, such as HP OpenView or SunNet Manager, to monitor and manage the switch.

WaveSwitch 100-8. List price: \$6,495. **WaveSwitch 100 FL.** List price: \$11,995. PlainTree Systems Inc., Waltham, MA; 617-290-5800; fax, 617-290-0963; e-mail, sales@plntree.isis.org; Web, <http://www.plaintree.com/plaintree>.

Circle 979 on reader service card

ISDN

ISDN Your Way From IBM

By Frank J. Derfler, Jr.

As is often the case with IBM products that target the consumer, the IBM 7845 Network Terminator packs in a lot of nifty features that are hidden behind off-putting terminology, packaging, and documentation. No, this isn't a futuristic robot sent back in time to disable the Internet; rather it's a great way to really use ISDN.

When you get ISDN service, it comes into your home or office on a single pair of wires called the U interface. Many ISDN products, however, require a four-wire interface called the S/T bus. An intervening box, called an NT-1, handles the connection between the two. If the ISDN product you're using doesn't have a built-in NT-1, you'll have to spend \$100 or more for a separate unit. But if you want to get the most out of your ISDN connection, you should think about spending a bit more for the IBM 7845 (\$350).

True, the 7845 is basically an NT-1, but it also lets you use those expensive ISDN channels as plain old telephone lines

with any telephone, modem, or fax machine. The 7845 even works with extra-charge phone services, such as conference calling and return dialing.

Physically, the 7845 is like a flounder: The box is clearly designed to sit flat under a phone, but it looks like it should stand on its side. That's okay, but the fact that the DIP switches on the back are upside down is downright confusing.

The 7845 is unusually heavy because it has its own 12-volt lead-acid battery inside. The battery is a backup device that keeps the phones alive when the power goes out.

When you set up the 7845, you have to tell it a few things about its world, such as its Service Provider ID (SPID) and phone number so that it can interact with the switch at your local RBOC. You do this by connecting a Touch-tone phone to the 7845 and entering a series of codes. One word of caution: Don't lose the manual, because the codes are not listed anywhere else.

You also use the telephone to tell the 7845 if the second ISDN B channel is to go to



RIGHT SIDE UP:

The IBM 7845 is a good product, but it's hard to figure out which way it sits.

the analog telephone devices or straight to the ISDN port. In our situation, the router runs fine on one B channel, but the videoconferencing system demands two. So when we go to video, we lose the phones.

During our installation we discovered that the 7845 was coded as a type-C terminal in the switch. We only had type-A (or basic) terminal service encoded in the switch. It took three days and a service charge to get the terminal type upgraded through the telephone company.

On the telephone side, you'll actually hear the fuzziness and distortion that the normal phone line clips off due

to lack of bandwidth (You're hearing how bad some telephone instruments really are). Using a high-quality phone like those in the AT&T 800 family, you'll be amazed at how good the connection sounds over the 7845.

Will you ever disconnect all of your regular telephone lines and only use ISDN? Probably not any time soon. But the IBM 7845 allows you to make use of those high-quality circuits for many other connections.

IBM 7845 Network Terminator. List price: \$350. IBM Corp., Research Triangle Park, NC; 800-426-2255; Web, <http://www.ibm.com>.

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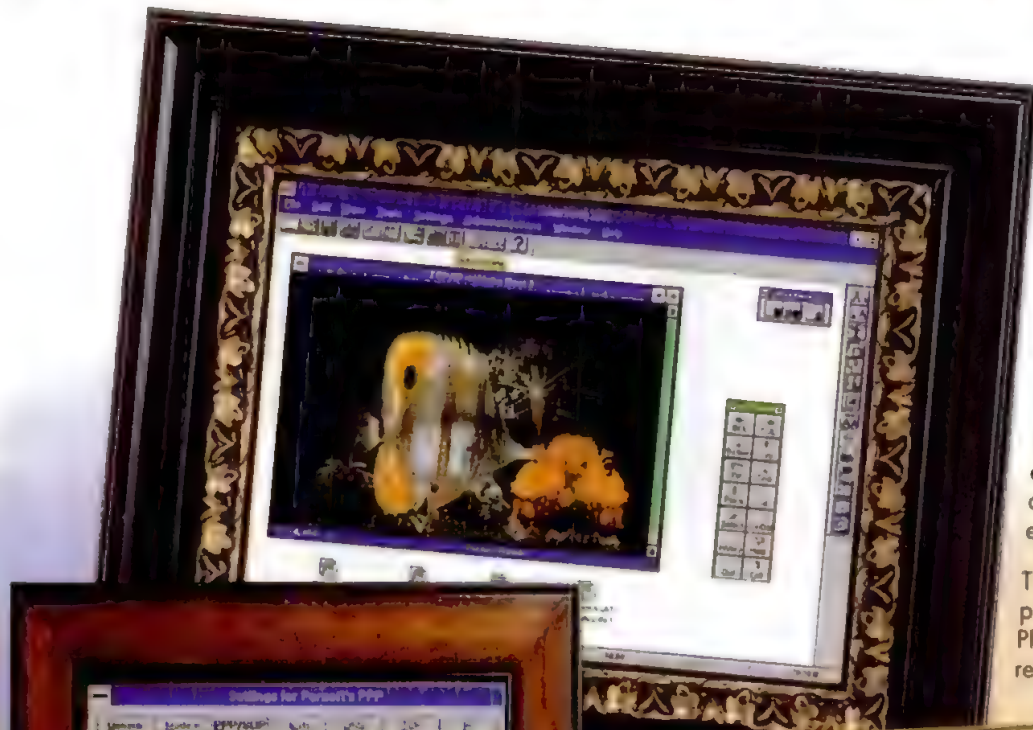
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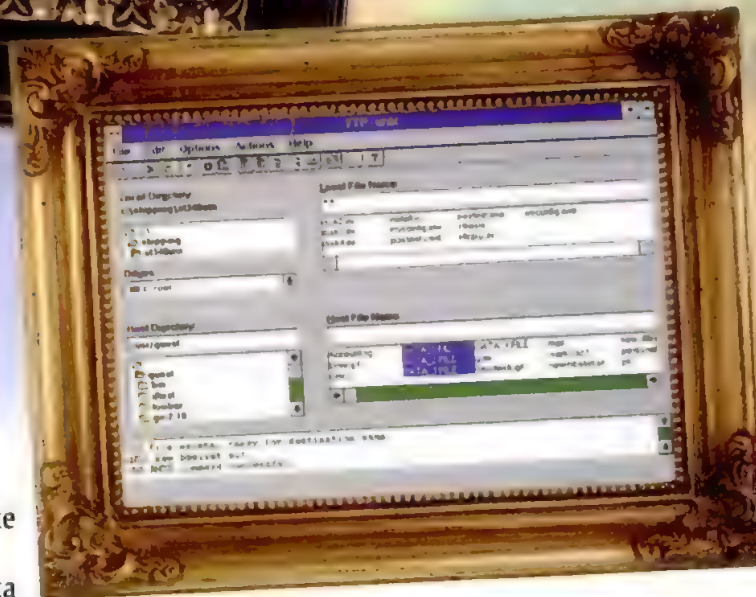
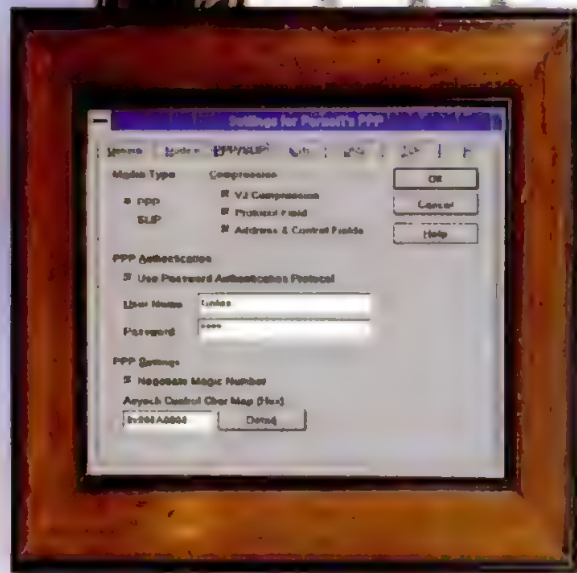
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NETWARE/WINDOWS NT INTEGRATION

Better Late Than Never?

By John Garris

Eight months after the release of Microsoft Windows NT 3.5, Novell finally has a solution for connecting Windows NT clients to NetWare servers. The NetWare Client for Windows NT is an alternative to the NetWare client software that ships as part of the Windows NT OS. The biggest advantage of Novell's client is its integration with NetWare Directory Services (NDS). In other areas, however, we found Microsoft's NetWare client superior.

Installing the new client drivers is easy: You simply use Windows NT's Network Control Panel to add the networking software and LAN drivers.

The installation process adds both the NetWare redirector and Novell's own IPX/SPX transport-layer software. You can run Novell's client over any of the NDIS LAN drivers provided by Microsoft, or you can use Novell's ODI drivers—although ODI drivers for only 18 network adapters were included with the version we tested.

Once the product is installed, you can access all of your network resources transparently, using standard File Manager and Print Manager operations.

There are some limitations to Novell's client software. For example, you cannot run any of NetWare's DOS utilities, such as SYSCON, from the standard

DOS prompt. Instead, Novell provides its own virtual DOS box to let you run these commands. Also, the Novell client doesn't work with NT's Remote Access Service (RAS) unless you also load Microsoft's NWLink IPX/SPX layer.

Shortly after the client was released, Novell released a patch for it (called NTRFT1). We advise you to use it. A number of times when we tried to map a drive letter to a NetWare 3.11 volume, our Windows NT client crashed, and the screen went blank. Novell's patch fixed this problem.

Novell's and Microsoft's client each implements a performance-enhancing protocol called *packet burst*. During our tests, we found that Microsoft's client sent large bursts for both reads and writes, while the Novell client only sent bursts occa-

sionally during writes to the server. Novell confirmed our finding.

To manage NetWare servers, Novell provides a 32-bit version of NWAdmin which has all the functionality of the 16-bit Windows version that comes with NetWare 4.1.

Overall, Novell's Windows NT client software is best suited for NetWare 4.1 environments where clients need to take advantage of NDS. Otherwise, you're probably better off sticking with Microsoft's client.

NetWare Client for Windows NT is available free at Novell's Web site (<http://www.novell.com>) and on CompuServe in the NOVLIB forum.

NetWare Client for Windows NT. List price: None (free on the Web and CompuServe). Novell Inc., Provo, UT. 800-638-9273; Web, <http://www.novell.com>.

Circle 983 on reader service card

THE NETWORKER By Diane Danielle

Tricks up Your Sleeve



Often all that separates an easy-to-manage LAN from a hard-to-manage one is a set of tricks. Here are two of my favorites.

DESKTOP SETUP AND MAINTENANCE

An associate, Steve Kalman, has a simple strategy for anybody who stores applications on the desktop for performance reasons but wants to control them centrally. All it takes is some spare server disk space and XCOPY. Build your standard desktop, then do an XCOPY using the /S parameter to copy that desktop (all directories, subdirectories, and files) to a server directory.

To set up a new computer, or if an existing one gets screwed up, just reverse the XCOPY and copy the server's image of the workstation to the desktop. Although this process is most useful for setting up and maintaining classrooms, it will also work well for business networks that have only a couple of different kinds of computers. Use the same technique to build a software-distribution system. This strategy won't work well if you want your users to be able to personalize their desktops.

NETWORKING WINDOWS

If you want to run Windows off your server but want a permanent swap file, you run into what may appear to be an insur-

mountable obstacle. Although the permanent swap file itself is on the local drive, with server-based Windows the file that points to it (SPART.PAR) must be stored on the server in the user's Windows directory (the one with WIN.COM and .INI files). This file is very hardware-specific. If a user moves from one computer to another, the "personal" SPART.PAR file won't match the physical swap file on the local drive.

A reader sent me a solution for people who use Saber Software's LAN Workstation: On each workstation, create a permanent swap file and record the size in K. After creating the permanent swap file, copy the SPART.PAR file from the Windows directory on the server to the root directory of the local drive. In SABER.WKS, for each workstation add a SET PERMSWAPSIZEK=xxxx line, where xxxx is the size in K. Have the logon script COPY C:\SPART.PAR to the user's Windows directory before invoking Windows. Use INIMAN to set the PermSwapSizeK (in [386Enh] in SYSTEM.INI) to %PERMSWAPSIZEK%.

This technique should work with any .INI manager that will let you use an environment variable. If you don't need such fine control over the contents of the SYSTEM.INI file, simply copy both the SPART.PAR file and SYSTEM.INI to the local hard disk after you've created the permanent swap file. Before you load Windows, check to see if those files exist on the desktop; if so, then just copy them to the server. You'll always have a correctly matched pair. Remember that SPART.PAR is created as a READ ONLY file, so you'll need to change the attribute.

Diane Danielle, an independent networking consultant, can be reached on CompuServe at 72241,2566 or MCI Mail at 383-1159.





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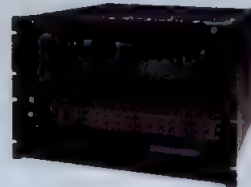
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New & Improved

NEWS OF ANNOUNCED PRODUCTS AND UPGRADES

By Eryn Brown

PC Card Modem and LAN Adapter in One

Sometimes a plain old modem can't provide the connectivity options you want when you're on the road. **Xircom's CreditCard Ethernet+Modem (CEM) 28.8** should solve some of your frustrations. The CEM 28.8 takes a V.34 data and fax modem and combines it with a full-duplex PC Card Ethernet adapter, which gives you the option of dialing in for remote access or connecting directly to a LAN. The card ships with ShivaPPP, WinFax Lite, WinComm Lite, and an SNMP agent.

CreditCard Ethernet+Modem 28.8. Estimated street price: \$400 per adapter (in six-pack). **Xircom Inc.**, Thousand Oaks, CA; 800-438-4526, 805-376-9300; fax, 805-376-9311; Web, <http://www.xircom.com>.

Circle 959 on reader service card



MODEM AND ADAPTER IN ONE: Xircom's CreditCard Ethernet+Modem multifunction PC Card.

NBase Expands Fast Ethernet Product Line

As Fast Ethernet installations continue to grow, switch options will follow suit. **NBase Communications** helps set the pace with the new MegaSwitch 100 Fast Ethernet switches. The base unit, the NH2007, has five 100Base-T ports and two expansion slots, for which NBase offers modules for Category 5 UTP and a variety of fiber-optic interfaces. The switches incorporate NBase's own selective flow control algorithm, and should feature RMON support by early 1996.

MegaSwitch 100 switches. List price: \$6,995 for base unit. **NBase Communications**, Chatsworth, CA; 818-773-0900; fax, 818-773-0906.

Circle 962 on reader service card



Citrix Release Extends Your Remote Office

Citrix Systems is making a great remote-access solution even better. With WinFrame for Networks, the company is taking the "application server" technology behind WinView—Citrix's release for OS/2—and applying it to a Microsoft Windows NT environment, making the product more scalable and easier to install.

By running applications where they operate most efficiently—over the network or locally—WinFrame optimizes network performance and increases remote-user capacity. The package, which works with all popular network protocols, runs on an Intel-based server upon which you install applications you want to run over the network. Once the server is up and running, WinFrame preserves remote-local transparency, so end users don't worry about where applications are. A standard Pentium server running at 60 to 90MHz can support at least 15 concurrent users.

WinFrame ships with security features and Windows-based management utilities that can run locally or from a remote node. The client software works with DOS, Microsoft Windows 3.x, Windows NT, and Microsoft Windows 95.

WinFrame for Networks. List price: \$5,995 (15 concurrent users). **Citrix Systems Inc.**, 800-437-7503; e-mail, sales@citrix.com.

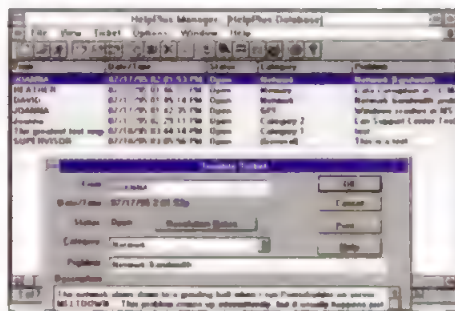
Circle 958 on reader service card

NetTools' New Trouble-Ticket Generator

With NetTools 5.3, **McAfee** makes improvements to tools that help you keep an eye on CONFIG.SYS, WIN.INI, and AUTOEXEC.BAT files across your network. New to the package is HelpPlus, a trouble-ticket generator, which finds GPFs and then sends a summary of the failing system's configuration to the administrator's desk. The summary can be dropped directly into any ODBC-compliant database or sent through e-mail. This version also adds enhancements to the Print Manager module.

NetTools 5.3. List price: \$19.50 to \$32 per node (two-year subscription). **McAfee**, Santa Clara, CA; 408-988-3832; e-mail, sales@mcafee.com; Web, <http://www.mcafee.com>.

Circle 961 on reader service card



EASY MANAGEMENT: NetTools generates a trouble ticket when you have a GPF.

HP Cuts Prices for 100VG Hubs and Adapters

One impediment to the widespread adoption of high-speed networking has been the cost. But times are changing. **Hewlett-Packard** has announced price cuts for its 100VG components. The 100VG-Hub 15 is now \$3,199, less than \$200 per port. The 10/100VG Selectable PCI LAN Adapter now sells for \$249 for a single unit—and as low as \$193 per unit if purchased in a 24-pack. **100VG-Hub 15.** List price: \$3,199. **10/100VG Selectable PCI LAN Adapter.** List price: \$249. **Hewlett-Packard Co.**, Santa Clara, CA; 800-533-1333; fax, 800-333-1917.

Circle 966 on reader service card

NETWORK EDITION

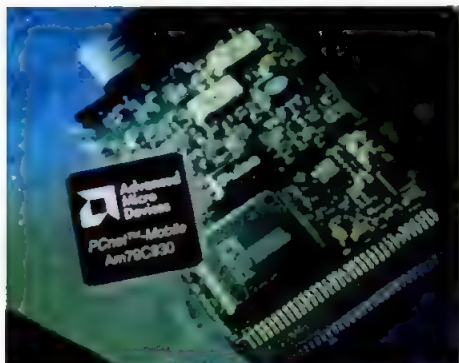
New & Improved

AMD Enters Wireless-LAN Marketplace

Making its initial entry into the wireless-LAN marketplace, **Advanced Micro Devices (AMD)** has announced a new chip, the PCnet-Mobile. The first single-chip media access controller to comply with the IEEE 802.11 wireless LAN standard, the PCnet-Mobile can be installed on PC Cards, motherboards, or any other entry point. All developers need to add in order to complete a connection is radio, antenna, and memory. Advanced Micro Devices will supply its customers with upgradable protocol firmware and NDIS and ODI drivers.

PCnet-Mobile. List price: \$29 (each, in quantities of 1,000). Advanced Micro Devices Inc., Sunnyvale, CA; 800-222-9323, 408-749-5703; Web, <http://www.amd.com>.

Circle 963 on reader service card



ENTERING THE WIRELESS-LAN MARKETPLACE: AMD is now selling the PCnet-Mobile chip.

Symantec Network Management for Win 95

In the world of PC utilities, there's no name more familiar than Norton. **Symantec's** newest addition to its Norton Network Series product line is the Norton Desktop Administrator 1.0. The package lets administrators design standard, enterprise-wide end-user interfaces, simplifying and streamlining user access to networked applications. The administrator can restrict access on a user-by-user basis, and even restrict specific versions of files. The package is compatible with DOS, Microsoft Windows 3.1, and Microsoft Windows 95 files and applications.

Norton Desktop Administrator 1.0. List price: \$450 (10 nodes). Symantec Corp., Cupertino, CA; 800-441-7234, 503-334-6054; Web, <http://www.symantec.com>.

Circle 964 on reader service card

BRIEFS

HARDWARE

Apexx Technology has announced the availability of the PCTalk MacLAN Connect Kit (\$359), a hardware/software bundle that provides bidirectional AppleTalk connectivity for Windows PCs and Macintoshes. Included in the package are Apexx's PCTalk LocalTalk Adapter and Miramar Systems' MacLAN Connect V5.0 software. 800-767-4858.

Belkin Components, known for its cabling products, has now expanded its line to include Category 5 Patch Cables. You can purchase the cables in standard lengths (3, 7, 14, 25, or 50 feet) or you can order them in custom lengths. They come in a variety of cable-jacket colors. List prices start at \$3.99. 800-223-5546, 310-898-1100.

Digital Equipment Corp. has announced improvements and price reductions to its 64-bit RISC AlphaServer line. In addition to the new AlphaServer 2000 5/250 SMP system, the company is offering new Internet-ready machines and reductions in the price of processor and memory upgrades. 800-457-8211.

Farallon Computing has announced price reductions in its 10Base-T Ethernet product line. The EtherMac Transceivers now sell for \$39 each (with volume discounts available) and Ether10-T Starlet hubs sell for as low as \$19 per port. The products link PCs, Macintoshes, and printers to networks. 510-814-5100.

SOFTWARE

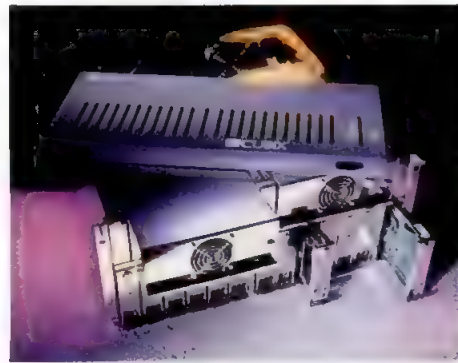
Beame and Whiteside is shipping a new version of BW-Connect NFS 3.6 for Microsoft Windows NT (\$548). The package is a Network File Systems solution for Windows NT networks. Including new NFS and Web-server capabilities, Version 3.6 features a new SMTP/MIME mail reader, Gopher, graphical TraceRoute, and a Network News Reader. 919-831-8989.

Cubix Lightens Your Mass-Storage Load

One of the biggest challenges of mass storage is sheer bulk: Where do you put your storage devices, and how do you manage them for maximum efficiency? **Cubix** offers one solution to the problem with SafeStor/FT. The SafeStor/FT uses a chassis-and-backplane structure, in which the drives are simply modules and are installed through a SCSI connection. The SafeStor/FT is rack mountable, can hold up to a dozen 3.5-inch drives, and comes with an intelligent environmental sensor that monitors elements such as temperature and disk utilization.

SafeStor/FT. List price: \$1,995. Cubix Corp., Carson City, NV; 800-829-0550, 702-888-1000; fax, 702-888-1001.

Circle 965 on reader service card



A WAY TO SAVE SPACE: The SafeStor/FT can hold 12 drives in a single rack-mountable chassis.

Instant Internet Access For Your LAN

Enabling Internet access on a LAN can be complicated: You have to protect your internal communications from cyberpirates. **Performance Technology's** Instant Internet 2.0 for NetWare is a hardware/software package that allows up to 50 concurrent NetWare or PowerLan sessions to connect to the Internet. It also tightens network security by isolating the TCP/IP stack to one machine. If you select the dual-Ethernet option, you can isolate Internet traffic on a separate LAN segment. Other features include multiple-box support and enhanced management capabilities. **Instant Internet 2.0 for NetWare.** List price: starts at \$3,495 (standard Ethernet configuration, 50 concurrent sessions). Performance Technology Inc., San Antonio, TX; 210-979-2000; fax, 210-979-2002; Web, <http://www.perftech.com>.

Circle 960 on reader service card

SURFER GIRL.



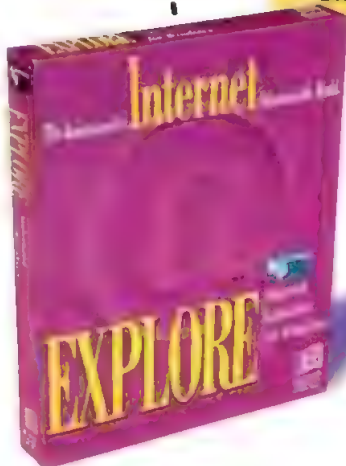
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Microsoft

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New & Improved

AsantéFast 100 Hub: Stackable Fast Ethernet

In an effort to smooth migration from Ethernet to Fast Ethernet network installations, **Asanté Technologies** has announced its new 12-port AsantéFast 100 Hub. The first stackable Fast Ethernet hub on the market, it works with PCs, Macintoshes, and workstations. It can be stacked up to five high and connected to cascading stacks through an RJ-45 uplink port, bringing total capacity to 118 ports. Also featured is National Semiconductor's NWay Auto-Negotiation technology, which automates connection to 10Base-T and 100Base-TX, as well as full-duplex modes for both. Many of these features are also supported by the AsantéFast 10/100 Adapter, introduced in June.

AsantéFast 100 Hub. List price: \$1,995. **Asanté Technologies Inc., San Jose, CA; 408-435-8388; fax, 408-432-7511; e-mail, sales@asante.com; Web, <http://www.asante.com>.**

Circle 967 on reader service card



STACKABLE FAST ETHERNET? You bet. The 12-port AsantéFast 100 Hub is now available.

Telco Tackles Frame- Relay Compression

Making sure you don't use up too much bandwidth is a necessity if you don't want to drop packets during burst-mode frame-relay transmissions. **Telco Systems'** new product, the Series 5000 Frame Relay Optimizer (starting at \$5,900), takes advantage of the company's Sequential Packet Compression scheme, which preserves compression histories for each Data Link Connection Indicator (DLCI), allowing greater compression. Less congested links can operate simultaneously at less intensive compression modes.

Series 5000 Frame Relay Optimizer. List price: Starts at \$5,900. **Telco Systems Inc., Norwood, MA; 617-255-9400; fax, 617-255-5885; e-mail, info@magna.telco.com; Web, <http://www.telco.com>.**

Circle 974 on reader service card

BRIEFS

HavenTree Software is shipping NodeMap for Windows (\$499), the Windows version of its DOS network-diagramming tool. The program auto-detects LAN and WAN configurations, saving you from drawing diagrams by hand. NodeMap polls the system to get network information and lets you edit drawings and manually insert undetected components. 613-544-6035.

Magic Solutions' SupportMagic for Windows (\$11,995 for 12 users) help-desk software is now linked to Lotus Notes 3.x. Users submit a help-desk request through an electronic form in Notes. Technicians receive and answer the request through Notes as well. The software generates confirmation notices for all response activities. 201-587-1515.

MDI, a division of Sybase, has announced an update of OmniSQL Gateway. Called OmniConnect Version 10.5 (\$2,200 and up), the software should be available by the time you read this. OmniConnect enables transparent read and write access to multiple, heterogeneous data sources and is fully compatible with Sybase SQL Server System 10. 303-443-2706.

Network General Corp. has added three new products to its network management line. Off-Net Sniffer Analyzer (\$4,995 to \$10,995) interprets collected data. Sniffer Lite (\$4,995) is a fault management product for midsize networks. Sniffer Reporter (\$2,495) composes management reports with data from the Portable or Notebook Sniffer Analyzers. 800-764-3337.

SilCom Technology is now shipping TR/Tracer for Windows (\$399), a Token-Ring network-monitoring application. Constructed with an easy-to-use user interface, TR/Tracer lets you view updates on topology and trends and notifies you if there's a problem. It also lets you browse RMON-derived MIB statistics. 404-964-9293.

CD Net: 56 CD-ROM Drives, One Server

You're not limited to 20-odd CD-ROM drives per server anymore. CD Net v1.0 for Windows NT, from **Meridian Data**, gives you the option of using up to 56 CD-ROM drives through a single drive letter. Individual drives appear in subdirectories. You can also access multiple CD-ROM drives through different drive letters. CD Net v1.0 also includes management features such as usage metering. The software connects to clients running OS/2, Microsoft Windows 3.x, Microsoft Windows 95, Microsoft Windows for Workgroups, or DOS.

CD Net v1.0 for Windows NT. List price: \$1,995. **Meridian Data Inc., Scotts Valley, CA; 408-438-3100; fax, 408-438-6816; Web, <http://www.meridian-data.com>.**

Circle 973 on reader service card



WHEN DOES 1 CD-ROM BECOME 56? When you load CD Net on your Windows NT network.

New ATM, Multiport Ethernet Modules

Cisco Systems is shipping two new interface cards for the Cisco 4500 three-slot modular router. The ATM OC-3 STS-3c/STM-1 adds ATM functionality, supplying 155-Mbps single-mode and multimode data transmission. The OC-3 ATM module can perform Multiprotocol Encapsulation (RFC 1483) and can transfer IP (RFC 1577) over ATM as well. The second card, the Ethernet Network Processor Module, has six 10Base-T ports, three times as many as Cisco's existing Ethernet card for the 4000 family.

ATM OC-3 STS-3c/STM-1 Network Processor Module. List price: Starts at \$9,500. **Ethernet Network Processor Module.** List price: \$6,000. **Cisco Systems Inc., San Jose, CA; 408-526-4000.** Circle 970 on reader service card

NETWORK EDITION

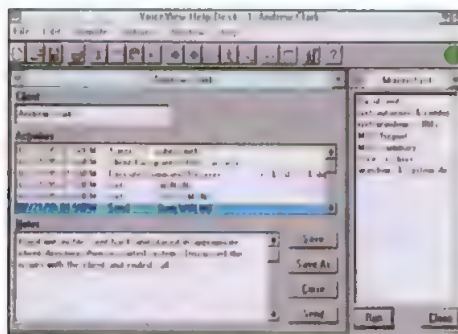
New & Improved

Cardinal Introduces Low-Cost Voice Modems

Once upon a time, it was prohibitive to set up a telephony solution in your office. Now, however, voice-capable modems are becoming widespread—and inexpensive. **Cardinal Technologies'** 14.4- and 28.8-Kbps voice/data/fax modems incorporate voice mail and Caller ID. They also work with **Radish Communications Systems'** Voice-View protocol, which lets you switch between voice and data functions during a phone call.

MVP144IV2 (internal). Estimated street price: \$90. **MVP144XV2 (external).** Estimated street price: \$100. **MVP288IV (internal).** Estimated street price: \$185. **MVP288XV (external).** Estimated street price: \$210. **Cardinal Technologies Inc., Lancaster, PA; 800-775-0899, 717-293-3000; e-mail, prodinfo@cardtech.com.**

Circle 971 on reader service card



VOICE AND DATA: Cardinal's new modems let you take advantage of Radish's VoiceView.

New 33.6-Kbps Modems From USR, Supra

Two manufacturers have announced the addition of 33.6-Kbps capabilities to their modems. **U.S. Robotics'** new software is already available at the company's FTP site. It enables 33.6-Kbps speeds for the Courier desktop modems and the Total Control Systems Products. **Supra** will ship new 33.6-Kbps products as soon as the ITU standards committee releases the new version of V.34, which will finalize the 33.6-Kbps speed standard. U.S. Robotics says that it is following the ITU's progress and expects its software to be compliant with the new standards.

V. Everything modem feature set. **U.S. Robotics Inc., Skokie, IL; 708-982-5010; FTP, ftp://www.usr.com.** **33.6-Kbps modems.** **Supra Corp., Vancouver, WA; 360-604-1400; e-mail, sales@supra.com; Web, http://www.supra.com.**

Circle 972 (Supra) or 984 (U.S. Robotics) on reader service card

BRIEFS

Teledata Solutions has announced shipment of Call Link for Windows (prices starting at \$2,500 per agent). A computer/telephone integration (CTI) system for Microsoft Windows 3.1, the package works with PBXs or Centrex on a LAN. Features include screen pops and automated fax-confirmation generation. 708-620-5298.

Trax Softworks has released TeamTalk 2.0 (\$395 for the 5-user version). This update of the group discussion product features new navigational tools, including the TopicMap; the ThreadMap (which helps to locate threads within topics); and Dynamic Topics, which lets any discussion topic participant create a thread on the fly. 800-367-8729.

Triticom is now shipping Simple-View Version 1.0 (\$495), an SNMP manager for Microsoft Windows. The software is able to query and control any TCP/IP-accessible SNMP device on a network. Features include a locate function to find a particular node, options for query-response presentation, and a built-in help system. 612-937-0772.

WRQ has begun selling Reflection SelectSuite, a universal client software package that your customize. You can choose from among any of the Reflection products, which run on a variety of machines and work with popular network protocols including TCP/IP, IPX/SPX, and NetBIOS. The software comes on one CD or a group of floppy disk. 800-872-2829.

ANNOUNCEMENTS

Emulex Corp. has announced an agreement with Novell that authorizes the bundling of Novell Embedded Systems Technology (NEST) 1.0 with Emulex's NETJet and NETQue multiprotocol print-server lines. NEST gives the print servers NetWare 4.0 capabilities that let users share information and resources across a network. 800-854-7112.

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New & Improved

LANHopper Extends Product Line to Fiber

Now there's a switched protocol analyzer for fiber-optic installations. **LANHopper Systems**, known for its wired network products, has introduced Glass-hopper, which will let you find glitches on your fiber-optic network (up to 72 sources) without having to move your analyzer. The product is able to handle a variety of transmissions without conversion, including ATM and ISDN. Glass-hopper ships with a proprietary control software package called PATH-master, which lets you name ports to simplify monitoring setups and also allows unattended switching. The product can work on any platform, and is protocol-independent.

Glass-hopper. List price: Starts at \$15,870. LANHopper Systems Inc., Atlanta, GA; 404-458-1044; fax, 404-458-1415.

Circle 975 on reader service card

BRIEFS

Proteon has announced that PlainTree Systems will license portions of Proteon's OpenRoute software suite in forthcoming Ethernet switching products. PlainTree joins several other companies that have licensed the package, including IBM and Digital. 508-898-2800.

Telematics International has announced that its new network management applications, some of which should be available by the time you read this, will work within the HP OpenView framework. OpenView will be the first platform to be integrated with the software, which monitors, configures, and controls Telematics products such as frame-relay switches and multi-service platforms. 305-772-3070.

AirLAN: Wireless Bridge For Token-Ring

It's getting easier and easier to take advantage of wireless technologies. **Solectek** is now shipping the AirLAN/Bridge Ultra (\$5,999), a long-range Token-Ring wireless bridge. The bridge allows high-speed bridging and routing and works between LANs up to 25 miles apart. It works in the 2.4-GHz Industrial Science and Medical band. Codeveloped with Cisco Systems, the AirLAN/Bridge Ultra complies with the IEEE 802.5 Token-Ring standard. It is compatible with most popular network operating systems. Solectek also offers an Ethernet version of the AirLAN/Bridge Ultra (\$4,999), which complies with the IEEE 802.3 Ethernet standard.

AirLAN/Bridge Ultra. List price: \$5,999. Solectek Corp., San Diego, CA; 619-450-1220; fax, 619-457-2681; e-mail, solectek@cts.com.

Circle 976 on reader service card

MULTIPLE ACCESS By O. Ryan Tabibian

Switch Access to the Rescue



Do you ever wonder what happened to the Virtual Office? The idea that we could have high-speed access to the outside world and that our homes would become extensions of the Internet and the corporate network. I remember being thrilled to hear that I could one day use my cable hookup as a high-speed connection to the Internet (instead of just as a main line to ESPN).

But the reality today remains much different. For most remote users, slow analog connections are still the only choice. For the (still) relatively few ISDN users out there, it's great to get the higher bandwidth, but they are already finding that technology's application somewhat limited.

In the next few months, a technology called *switch access* should change the face of remote access as we know it. Two trends will be the catalyst for this dramatic change. First, frame relay, a shared rather than dedicated higher-speed access, has proliferated and is the choice of many companies for their wide area connectivity. Many organizations are shedding their dedicated T1 and Switched 56 links in favor of the more robust and flexible frame relay. This has resulted in double-digit growth in frame relay for most carriers.

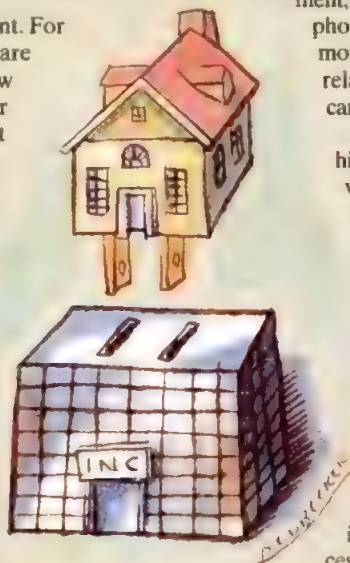
The second trend is the increase in the deployment of ISDN in homes. More and more regional Bell companies are realizing the importance of providing low-cost ISDN access. But the question remains how to merge these two disparate technologies to make a cohesive network? A number of phone companies and frame-relay carriers are claiming that switch access will be the catalyst for such a change.

Switch access will allow you to use the ISDN link to dial into a local frame-relay cloud rather than other ISDN lines. The benefits are clear: You make the ISDN connection in your home and become another node in the frame-relay cloud and thus an extension of the company's network and the Internet.

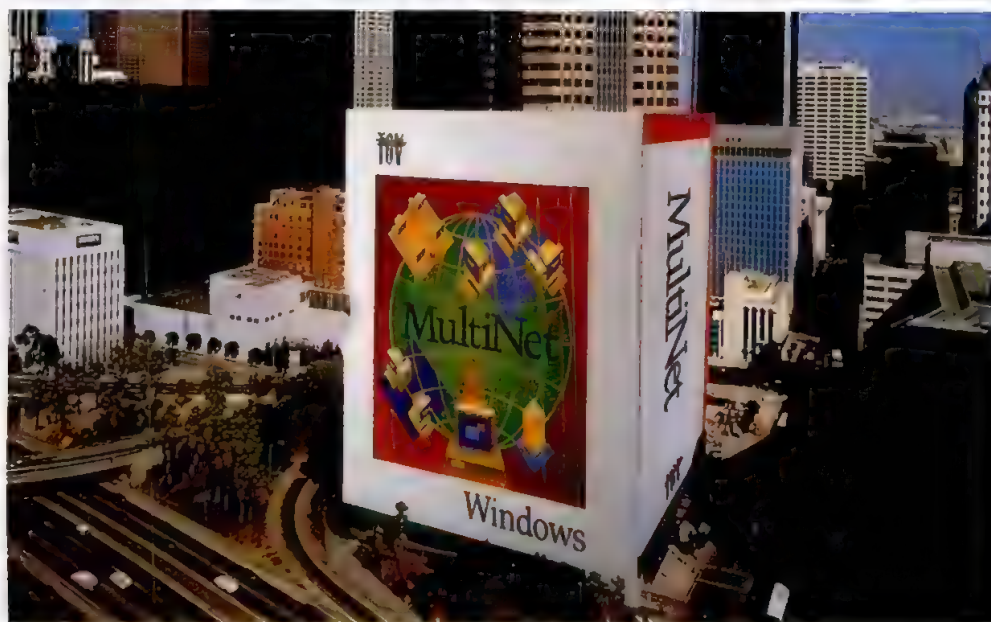
But isn't ISDN by itself a viable solution for remote access? Yes, but you've got some clear reasons for using frame relay instead of direct ISDN connection: lower cost, simpler management, and better performance. ISDN, like standard phone lines, is subject not only to a standard monthly fee, but also to toll charges. With frame relay, while there is a monthly access fee, most carriers do not impose toll charges.

The other benefit of frame relay is its much higher performance for a lower cost compared with dedicated connections. With frame relay you never have to pay for the possible maximum throughput of the line (the rates are designated by the Committed Information Rate or CIR), the maximum bandwidth that the carrier will guarantee. But even though you don't pay for it, you still can burst above that CIR, if the carrier's backbone is not congested. If the network is congested then the carrier typically implements a stop bit that drops all traffic above the CIR.

While it is clear that the Virtual Office, is about as real as virtual reality, switch access holds a lot of promise in helping enhance the remote-access experience.



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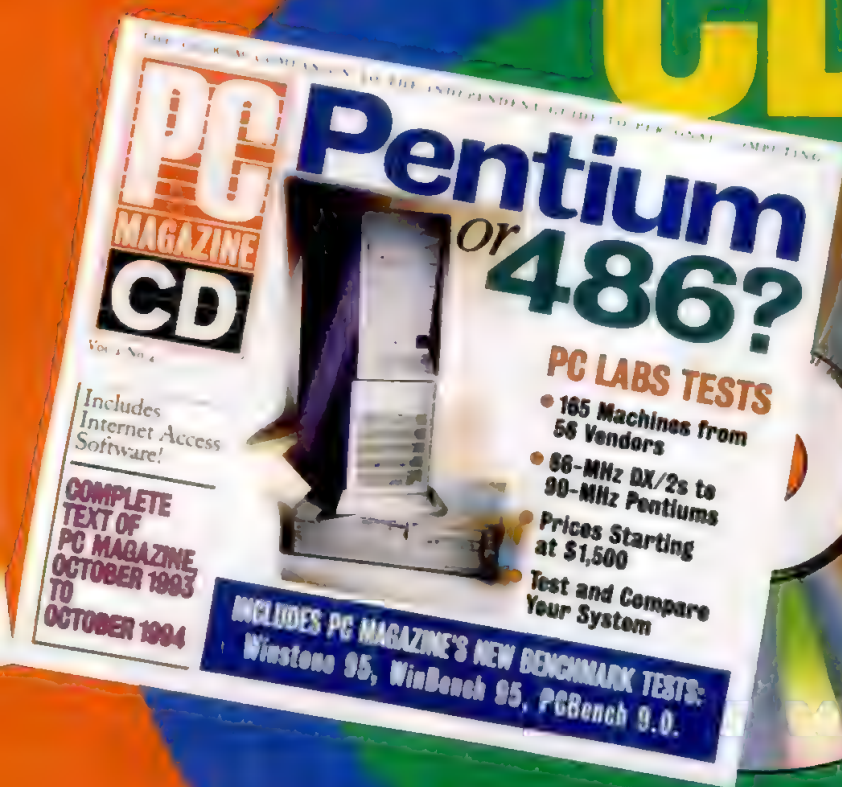
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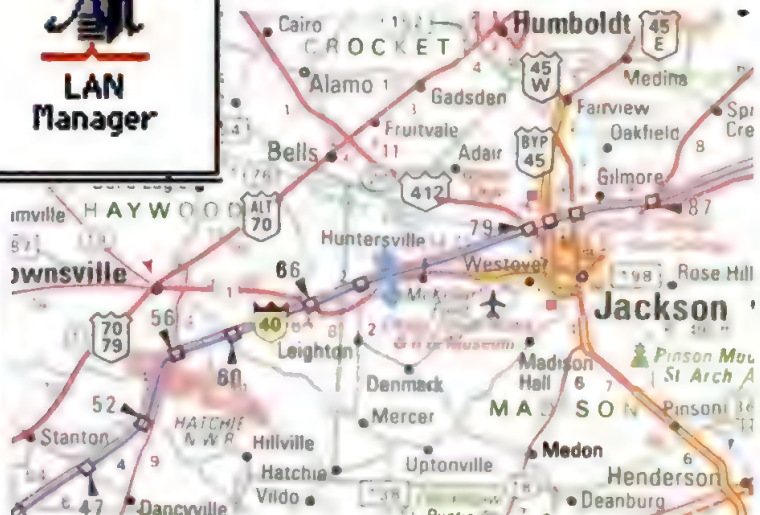
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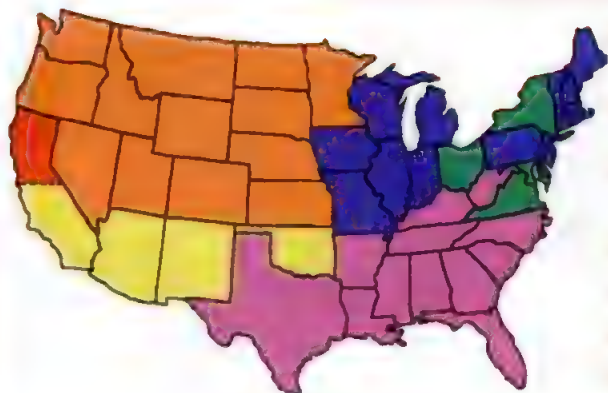
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CIRCLE 304 ON READER SERVICE CARD



Your Next OPERATING SYSTEM

By Michael J. Miller

The wait for Windows 95 is over at last. Microsoft has delivered final code for its long-awaited operating system, and now you can get on with the serious business of figuring out whether or not this is the OS you should be running.

To help you decide, PC Labs has put the shipping version of Windows 95 through exhaustive tests, systematically measuring its performance, stability, capacity, and compatibility against the dominant operating systems on today's PCs: Microsoft Windows 3.1, Microsoft Windows for Workgroups 3.11, IBM's OS/2 Warp Connect 3.0, and Microsoft Windows NT Workstation 3.51.

DOS'S DAYS ARE NUMBERED

One thing is clear: Even though the overwhelming majority of *PC Magazine* readers are running Windows 3.1 today, we're firmly convinced that the days of MS-DOS and Windows 3.1 are numbered. The advent of new, more sophisticated operating systems and the market acceptance of fast PCs with ample RAM and hard disk storage at reasonable prices mean that you no longer have to cope with the limitations of DOS and Windows 3.1.

Whatever advanced operating system you'll be



Today's 32-bit operating systems are a logical match for the native 32-bit architectures of advanced microprocessors like the 386, 486, and Pentium. Under a 32-bit OS, programs can manipulate 32-bit chunks of data and address large memory areas in a logical, streamlined manner. Application code can be smaller and, depending on the type of operation it is performing, noticeably faster. A 32-bit architecture is also a big win for programmers, who no longer have to wrestle with the Byzantine complexity of 16-bit segments and offsets.



Windows 3.1's simple *cooperative multitasking* scheme is often everything but cooperative. The three 32-bit contenders poised to succeed it offer *preemptive multitasking*, a far more robust way for the OS to divvy up system resources. The unit that is multitasked is a program *thread*, a fully functional subset of a program. Your apps can have multiple threads performing separate tasks at the same time. The net result is far smoother multitasking, better program response, and less waiting for the hourglass to go away.

using in the next few years, many of its characteristics are already clear. All the contenders are, at least in large part, 32-bit designs that support 32-bit applications with far more advanced features than the 16-bit DOS and Windows software we're used to. At the same time, these new OSs can run most of those existing 16-bit applications. All provide more protection for these new applications, so that one errant program won't be as likely to crash the whole system. All offer true multitasking (the ability to run multiple programs at the same time) as well as multithreading (the ability to have a single program do multiple things at the same time). All provide (or, in the case of Windows NT, will soon provide) a new user-friendly interface with object-oriented characteristics. And all offer broad network connectivity out of the box.

NOISY ARRIVAL

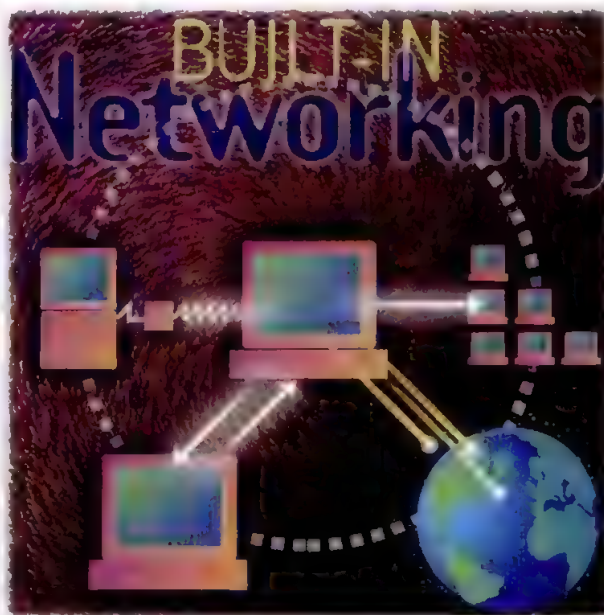
Windows 95 comes into this market surrounded by a glow of novelty, but in many ways, it simply builds upon the fea-

Will Windows 95 be your next OS? What about OS/2 Warp Connect? Or Windows NT? Should you stay with Windows 3.1? It's time for a tough choice.

tures of earlier operating systems. The basic architectural design of a 32-bit, protected, multitasking, multithreaded OS isn't new. OS/2 has been offering these features for years; it was followed by Windows NT, and both were preceded by variants of Unix. The new set of networking features in Windows 95 builds on features offered in Windows for Workgroups 3.11 and Windows NT. Even Windows 95's user interface has precedents: A desktop look with files and folders was popularized by the Macintosh more than ten years ago, and the taskbar follows in the tradition of utilities like

Starfish Software's Dashboard and OS/2 Warp's Launch Pad. It's the slick combination of all those features—along with others like the convenient Plug and Play standard—that makes Windows 95 worthy of the attention.

The most important question is one of execution: How well does Windows 95 do in the critical measures of performance, stability, and compatibility compared with its competitors? Are any of the alternatives worth the effort it takes to switch over?



Windows 95 and OS/2 bring a potent object-oriented metaphor to the user interface. Your screen becomes a true desktop, and you can use it to host objects representing programs, files, drives, devices, and directories. An object-oriented shell also has the intelligence to tell you about the objects it contains. Right-clicking on any object brings up a context menu with details on all its properties and all the things you can do to it. Windows NT still uses the old Windows 3.1 interface, but a slick Windows 95-style shell is in the works.

At last, networking has become a standard OS component. When you switch to an advanced OS, you will also be getting connected. Out-of-box support for Novell and other common PC LANs is commonplace, and TCP/IP is fast becoming a standard part of OS bundles. Connectivity features may also include priceless aids for mobile users such as remote dial-up and high-speed cable connections. To hook up to the rest of the world, OS/2 Warp provides a World-Wide Web browser to get you on the Internet; Windows 95 offers a browser in Microsoft Plus!

In the sections that follow, we answer these questions. We start with an overview of each of the operating systems, summarizing the findings of our recent tests as well as our earlier examination of the features of each environment. (See "Getting Ready for Windows 95," May 16, 1995, which contains more details on each of the operating systems as well as a complete look at their architectures and networking features.) We then go into more detail on the underlying design of each system and follow that with in-depth testing of performance, stability, and compatibility.

THE BOTTOM LINE

What are you trying to accomplish with your computer? Answer that question, and you'll be well on your way to knowing which OS to use. There is no single "best" OS that's the right choice in all cases. That said, the right OS for you is the one that best runs the applications you want, taking into account its system requirements and your compatibility concerns.

If you have a machine with 4MB of memory that runs well enough for you, and you don't want to upgrade your hardware, stick with DOS and Windows. This setup

works pretty well for most people and has an enormous base of software support. While developers are now designing 32-bit applications, the huge installed base of Windows 3.1 and Windows for Workgroups 3.11 assures that you'll have application support for a long time to come.

If you have at least 8MB of memory and an extra 60MB of hard disk space, or are willing to upgrade, then Windows 95 is the compelling choice. It offers all its new features with little upgrade pain. In our tests, it installed relatively easily in most circumstances, did well in compatibility

Features of Your Next OS: *Despite their differences, all the new 32-bit*

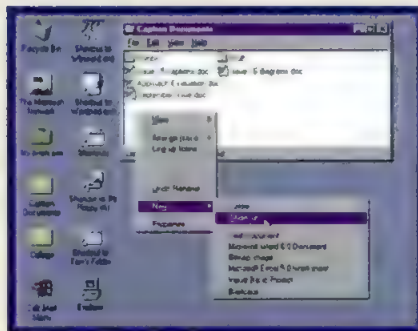
MICROSOFT WINDOWS 3.1 & 3.11

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USER INTERFACE

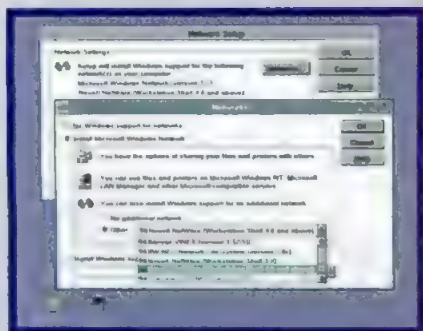


► Nothing new here. File Manager can't read Program Manager groups, and your groups stay stuck in Program Manager. You can't drag documents or programs to the desktop. There has got to be a better way.

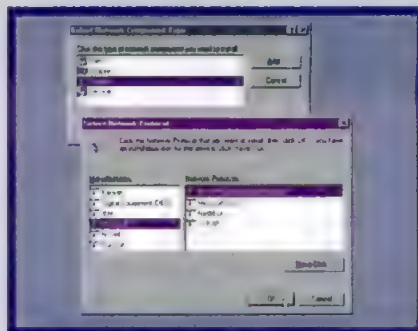


► The Windows 95 interface offers a true desktop with icons for programs, documents, directories, and system components. Context menus, accessed by right-clicking, give you the relevant actions and properties for any object.

NETWORKING

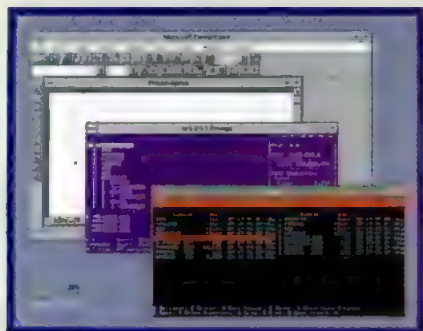


► Windows 3.1 is mildly network-aware, but Windows for Workgroups actually includes peer-network capability in the box. It also lets you configure Windows with many standard third-party networks such as Novell NetWare.

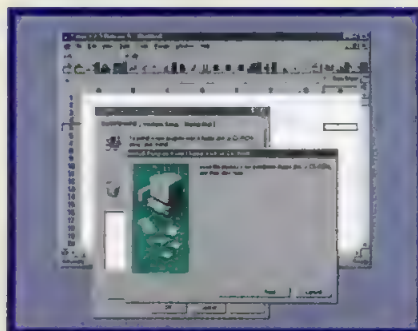


► Windows 95 comes out of the box with a nice suite of popular network protocols and an impressive collection of network adapter card drivers. Utilities like Network Neighborhood make server navigation extremely easy.

COMPATIBILITY



► In addition to running its native 16-bit and Win32s applications, Windows 3.1 supports most of your old-standby character-mode DOS applications, which you can run either in a windowed session or full screen.



► Compatibility with 16-bit Windows programs is near perfect, and installation is the same for 16-bit and native apps. You can also continue to use your 16-bit device drivers if you need to. DOS programs are well supported, too.

COVER STORY

Operating Systems

tests, and performed somewhere between Windows 3.1 and Windows for Workgroups 3.11 in many performance tests.

That's not to say that Windows 95 is perfect: It isn't. It makes trade-offs for the sake of backward compatibility and can't offer the level of crash protection offered by OS/2 or Windows NT. Like most new programs, it has a number of small glitches. And the total cost of upgrading is more than just the cost of the software; there are associated costs for hardware upgrades, the time to install, and retraining. Still, you end up with a more stable envi-

ronment, get a better interface, and have the ability to run new applications while still remaining highly compatible with the old. In short, we find Windows 95 the best choice for most PC users.

If you really want security and protection, and the ability to run most existing Windows programs and new Windows programs under development, then Windows NT should be your choice. It was the most robust operating system we tested, and the fact that its API is almost identical to that of Windows 95 guarantees that many applications will be available for it. The cost, how-

ever, is steep. Aside from being the most expensive operating system in this comparison, you'll need a fast machine with at least 16MB of memory to run it.

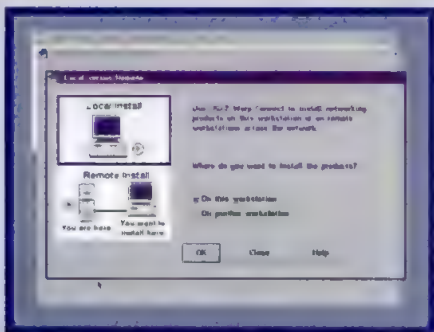
You'll also give up compatibility with DOS device drivers and applications—including many popular games—that write directly to the hardware. Currently, it offers only an unfinished version of the new user interface introduced in Windows 95, although a final version is scheduled for release by early 1996. Other features such as Plug and Play are further away. Windows NT makes sense for corporations

operating systems are converging on a similar set of features.

IBM OS/2 WARP



► OS/2 Warp gives you a rich shell environment complete with folders, icons, right-click-accessible context menus, the LaunchPad, and full drag-and-drop support. In fact, it looks a lot like Windows 95—but OS/2 Warp had it first.

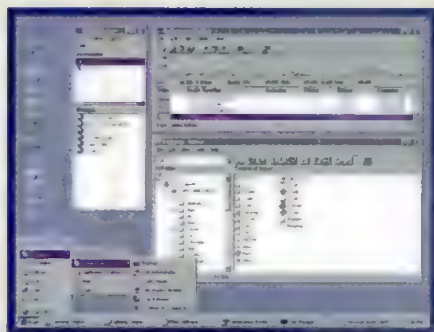


► Built-in client networking in OS/2 Warp Connect, which includes a robust TCP/IP stack, a NetWare client, and Internet access, is very complete. But installation can be complex. Be prepared for some tweaking.

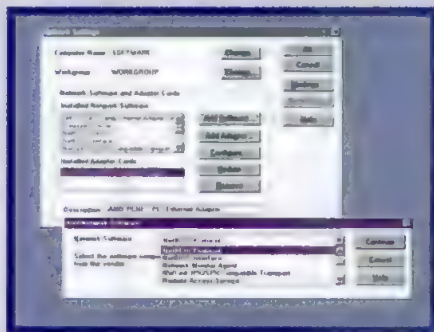


► OS/2 Warp's support for 16-bit Windows apps is impressive. Depending on which version you buy, OS/2 Warp runs them using IBM's WIN-OS/2 libraries or actual code from Windows 3.1. It can't run real-mode device drivers.

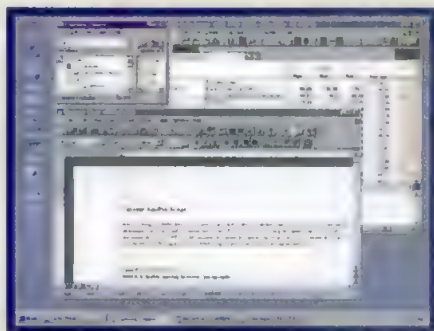
MICROSOFT WINDOWS NT



► Officially, Windows NT Workstation uses the Windows 3.1 interface. Unofficially, a Windows NT beta of the Windows 95 interface is already being circulated. Microsoft expects to ship the final version by the end of the year.



► Networking is an integral part of Windows NT Workstation. Out of the box, you get Client Service for NetWare, an IPX/SPX-compatible protocol, FTP Server capability, a TCP/IP stack, Remote Access client and server, and more.



► Windows NT Workstation runs most 16-bit Windows apps, but it won't run real-mode device drivers. Native Windows NT applications have been scarce up till now, but many upcoming Windows 95 apps will be Windows NT-certified.

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developing mission-critical applications, but while it may be the operating system of the future, it doesn't yet appeal to the average individual user.

OS/2 Warp Connect 3.0 stakes out a middle ground. It's the right environment if you want somewhat more protection than Windows 95 but don't need the protection or have the system requirements for Windows NT. It does a very reasonable job of running existing Windows applications, although it's somewhat slower than Windows 3.1 or Windows 95.

It remains to be seen whether IBM can convince software vendors to adapt their 32-bit titles for OS/2 Warp or create significant new applications for the platform. Installation and hardware compatibility, while improving, still are problematic. OS/2 Warp Connect 3.0's built-in applications and broad networking support make it a good step up for businesses that currently run OS/2 applications. In addition, OS/2 Warp is likely to satisfy those who want to run a non-Microsoft environment on x86-compatible hardware, whether because they don't like Microsoft, are concerned about its increasing dominance in PC software, or just want an alternative.

For most people, the choice will come down to staying with Windows or upgrading to Windows 95. Given the support for Windows 95 among both hardware and software developers, it seems quite likely that Windows 95 will become the dominant PC OS over the next 12 months.

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Your Next OS

The Big Picture

Windows is showing its age and three competitors are poised to take its place. Compare their strengths, features, and vulnerabilities.

By Michael J. Miller

SINCE ITS INTRODUCTION FOUR YEARS AGO, Windows 3.1 has become the de facto operating system standard in the PC industry. Windows 3.1 or Windows for Workgroups 3.11 come preinstalled on over 80 percent of new PCs, and Windows applications account for over 60 percent of all PC software sold. Still, given that Intel introduced the 32-bit i386 microprocessor ten years ago, 16-bit Windows is definitely showing its age.

Windows 3.1 stands on the architectural foundations of Windows 3.0, which was introduced in 1990. It loads on top of DOS, which provides many basic OS services. On top of the DOS infrastructure, Windows adds a graphical operating environment and features like the simple cooperative multitasking scheme it uses to run multiple Windows and DOS applications.

The Windows architecture puts all applications and system code into a single address space. This means that a misbehaving application can scribble on the memory being used by the operating environment itself or by another application. The result is the dreaded General Protection Fault. Sometimes Windows recovers gracefully; most times it can't.

Windows 3.x is inherently a 16-bit operating system, so programs address

memory in 64K segments and manipulate data in 16-bit chunks. Aside from driving programmers to distraction, this system can be less efficient than 32-bit addressing when large amounts of data are involved. Limits to system resources are another consequence of a 16-bit foundation. Windows 3.x offers limited storage space for structures such as application file handles. When these small memory areas fill up, Windows can't load new apps, even when

there's plenty of free memory left.

The Windows user interface, based on Program Manager and File Manager, is familiar to most PC users. The environment includes a Control Panel for managing the environment and a series of small applications, including Notepad, Write, Paint, Terminal, and the ever-popular Minesweeper and Solitaire games.

Windows for Workgroups added a group of network features. The most prominent was peer-to-peer networking, which lets you share a drive or directory with other users, either using Windows' built-in networking features or over a larger server-based network, such as Novell's NetWare or Windows NT.

In addition, Windows for Workgroups added a client for Microsoft Mail and for Schedule+, Microsoft's e-mail and scheduling application.

Windows for Workgroups added a client for Microsoft Mail and for Schedule+, Microsoft's e-mail and scheduling application.



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WE'VE WORKED WITH MICROSOFT
TO MAKE SURE WINDOWS 95 USERS
GET WHAT THEY NEED.**

You've waited. And waited. And now it's here. The most powerful PC operating system known to man and mouse.

But before you settle down to work in the 32-bit world of Windows 95, there are a few things you should know.

INFECTION PREVENTION IN THE NEW WORLD.

First, Windows 95 doesn't have any virus prevention or protection built in.

And on the networked, file-sharing superhighway of life, the chances that your PC will be exposed to a virus are far greater

than you might think.

And guess what? Your old anti-virus software won't work in the brave new world of Windows 95. But thousands of old viruses will.

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Norton AntiVirus is verified to protect you from 100% of all viruses known to be in circulation.*

Norton AntiVirus for Windows 95 protects you from virus attacks.

But you need more than just protection from a long list of known viruses. Which is all that ordinary anti-virus packages can offer.

Norton AntiVirus also offers you the most complete protection from unknown viruses. Thanks to our unique virus detection technology, Norton AntiVirus spots virus activity in your system and eradicates it before it can do any serious damage.

So even if you encounter a virus that was just created yesterday by some hacker with a bad frozen pizza habit, Norton AntiVirus will find it and stop it.

And when could you possibly need protection from unknown viruses more than in a brand-new operating system?

A 32-BIT OPERATING SYSTEM DEMANDS 32-BIT PROTECTION.

Another thing you may not know is that your old 16-bit utilities won't work in Windows 95.

Work faster and more productively with Norton Navigator for Windows 95.



PREVENTION, PROTECTION WINDOWS 95

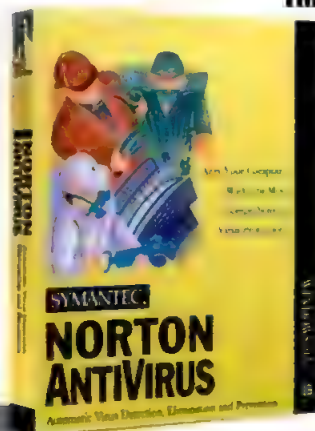
And the utilities included in Windows 95 itself won't give you much protection in a 32-bit world.

Only native 32-bit utilities can give you adequate system protection in a 32-bit environment.

Which is why you need to upgrade your utilities to Norton Utilities® for Windows 95.

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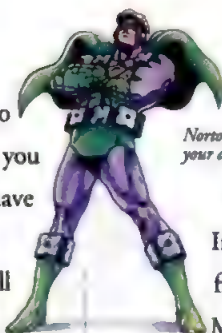
1995. **Trade-up editions will run only when specified Symantec, Central Point, McAfee and Norton Navigator is a trademark of Symantec Corporation. All other brand names or trademarks.

And if something does go wrong, Norton Utilities gives you the data recovery tools users have relied on from day one.

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**THE MORE WORK YOU DO,
THE MORE WORK NORTON
NAVIGATOR WILL DO FOR YOU.**

Windows 95 has lots of terrific features to make life easier. Like Plug 'N Play. And long file names.



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You can plug into your Internet connection right from the Norton File Manager. Search for text strings within files at least ten times faster. (In fact, the more files you have and the bigger they are, the more time you'll save.)

And copy a file anywhere on your hard drive or on the network with just one click. Instead of click

click click
click click
click click
(are you
tired of
clicking?)
click click

AND PRODUCTIVITY FOR FROM DAY ONE.

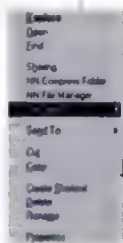
But what about getting even more out of Windows 95? Like getting more done in less time.

With Norton Navigator, you can navigate through your desktop five times faster than in Windows 95. Be more productive with multiple project-oriented desktops. Open the files you need most in a single click.

And that's just the first minute.

click click. Which is generally how long it takes to copy a file in Windows 95.

Norton Navigator also lets you use long file names for most 16-bit applications.



*Norton Folder Navigator
extends your menu power.*

And gives you loads of other time-saving tools like built-in PK-Zip compatible file compression and the ability to delete, move, zip or encrypt from any Open or Save dialog box.

So why waste time wading up and down menus, clicking your life away? Every minute counts.



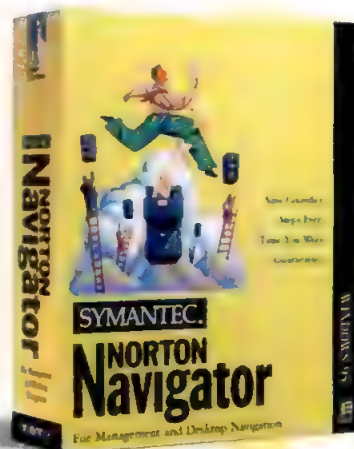
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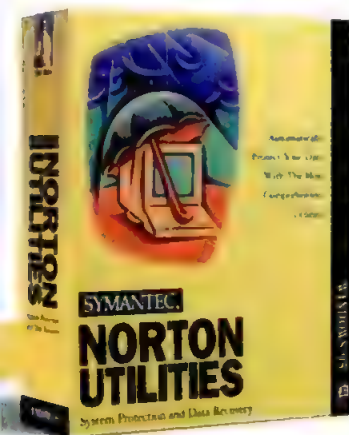
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uling packages. For non-network users, the big advantage of Windows for Workgroups was its 32-bit virtual device driver (VxD) for the file system. This can provide dramatically improved performance on many IDE drives.

While Windows has been justifiably criticized for its lack of memory protection and crude multitasking features, it did provide a big step forward over DOS and previous versions of Windows. For those with slower systems and limited RAM, it may still provide the best alternative.

WINDOWS 95

Like any product with a large number of features aimed at a huge market, Windows 95 builds in a number of trade-offs. Many of its impressive enhancements will be appreciated by PC users, but in some areas, Windows 95 is still just catching up with competitors.

From a basic architectural viewpoint, Windows 95 is a true 32-bit, preemptively multitasking, multithreaded operating system, bringing it in line with such competitors as OS/2, Unix, and Windows NT. It supports native 32-bit applications written to the Win32 API (which is also supported in a near-identical form by Windows NT). Native Windows 95 applications use a flat 32-bit address space, making them potentially faster at handling large amounts of data.

The most important trade-offs in the design of Windows 95 come from Microsoft's decision to make it compatible with existing 16-bit Windows applications and real-mode device drivers. This allows Windows 95 to work with a far wider range of existing hardware and software than OS/2, Unix, or Windows NT. The disadvantage is that the memory areas containing 16-bit apps and real-mode drivers must remain unprotected. It's still relatively easy for buggy software to crash the whole environment.

Within Windows 95, each 32-bit application runs in its own address space, but they all share the same 32-bit system code. A bad 32-bit app can still crash everything. All 16-bit Windows apps share a common address space, so they're just as vulnerable to each other as in Windows 3.1. But in testing, we ran Windows 95 on a great number of systems with relatively

Microsoft Windows 3.1 and Microsoft Windows for Workgroups 3.11

QUICK TAKE Microsoft Windows 3.1 and its network-capable sibling Windows for Workgroups 3.11 are showing their age. The Windows interface is functional for advanced users, but its lack of a true desktop and its separate Program Manager and File Manager functions make things harder than they should be for everyone. The bundled applications are lightweight, and the limited or nonexistent network connectivity is now substandard.

The 16-bit Windows architecture is a stripped-down design that dates from the days when 286 processors and limited RAM were the norm. All applications and system code run in a single, shared address space for maximum efficiency and minimum working-set size, but this exposes the entire system to crashes if any component misbehaves. Windows 3.x uses a simple cooperative multitasking scheme that cannot guarantee even allocation of system resources to multiple applications.

Those with 486 systems or better and 8MB RAM or more should certainly consider upgrading to a 32-bit OS. While users with slower PCs and limited memory may not see performance benefits from an upgrade, they will get the benefits of an improved user interface.

PERFORMANCE The 16-bit versions of

Windows are still the performance leaders—but by a thin margin. Windows 95 comes very close and even surpasses them in a few operations. In disk-intensive tasks, Windows for Workgroups generally offers better performance than standalone Windows 3.1 thanks to its 32-bit virtualized file system driver. Although Windows 3.1x versions will run in 4MB of RAM, we recommend 8MB for adequate performance.

COMPATIBILITY We encountered some incompatibilities with DOS games such as DOOM II that were unable to run in a Windows DOS box.

Bundled applications. With Windows 3.1 and Windows for Workgroups 3.11: Calculator, Cardfile, Character Map, Clock, games, Media Player, Notepad, Object Packager, Paintbrush, Recorder, Sound Recorder, Terminal, Write. With Windows for Workgroups: Remote Access.

Bundled network clients. With Windows 3.1: None. With Windows for Workgroups 3.11: Microsoft Windows Network client, Microsoft Mail client, Schedule + client.

Estimated street price. Microsoft Windows 3.1: upgrade version, \$60; full version, \$109. Microsoft Windows for Workgroups: upgrade version, \$65; full version, \$149.



For years, Windows 3.1 has been a familiar sight. But unintuitive design left many struggling with basics such as File Manager.

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The most powerful PC operating system you've

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background, monitoring your system and automatically launching tools to maintain system performance and prevent system crashes.

Of course, if your system does

Norton Utilities for Windows 95 keeps running to help you recover.

That's the beauty of our native, 32-bit utilities.

No other utilities can

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The first thing Norton Utilities for Windows 95 will do for you is tune up your system for Windows 95 by optimizing your hard drive and cleaning out all of the files you no longer need.

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background, monitoring your system and automatically launching tools to maintain system performance and prevent system crashes. Of course, if your system does crash or you accidentally erase a file, Norton Utilities for Windows 95 gives you the data recovery tools users have relied on from day one.

Even if other applications crash,

continuous, real-time protection and data recovery in the brave new world of Windows 95.

PROTECT YOUR DATA FROM DAY ONE.

And like every software product from Symantec, Norton Utilities for Windows 95 comes with a full sixty-day money-back guarantee.

So you've got nothing to lose. Except your data. Get your trade-up edition of Norton Utilities for Windows 95 today.

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Tunes up disk space and provides a comprehensive pre-installation physical

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Continuously monitors all vital resources and data integrity. Alerts you to impending disaster and recommends action or fixes problems automatically.

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few complaints. In practical terms, it seems generally more stable than previous Windows versions.

The Windows 95 user interface represents a big and obvious change. You use the Start button to launch applications or documents with their associated applications. As you launch programs, they appear on a taskbar normally positioned at the bottom of the screen. Clicking on any taskbar button switches to that program. It's a more intuitive style of task switching than any we've seen before.

Program Manager and File Manager have been replaced by a desktop metaphor where your files are shown as icons within folders (directories). For more complex file management, Windows 95 includes the Explorer, essentially a replacement for File Manager that gives you a tree-based view of your computer and its connections. Through an extension to the FAT file system, filenames are no longer limited to eight characters plus a three-letter extension; you can use names up to 255 characters long.

Other welcome changes in the user interface include the use of animated icons and tabbed dialog boxes. In general, we find the new interface to be a significant improvement over Windows 3.1, though old Windows hands will need some acclimatization. Of course, Windows 95 didn't invent the folder-based desktop metaphor or long filenames; they have long been part of user interfaces from the Macintosh all the way through OS/2's Workplace Shell.

Windows 95 augments the number and quality of bundled accessories, which range from the traditional calculator and games to powerful system-monitoring tools (for details on the applets bundled with all the operating systems, see the sidebar "Extras and Add-Ons: A Comparative View").

Big improvements are also apparent on the communications side. The operating system now comes bundled with Exchange, designed to be a universal mail inbox. It works as a client inbox for Microsoft Mail, the promised Microsoft Exchange Server and other MAPI-capable mail systems, and the Microsoft Network. It also works with the built-in Microsoft Fax for sending and receiving faxes.

Networking features have been im-

Microsoft Windows 95

QUICK TAKE Microsoft strongly positions Windows 95 as the successor to Windows 3.1 and Windows for Workgroups 3.11. It looks very well adapted to that role, a great choice for mainstream users.

A great new interface with a true desktop, folders, and a taskbar offers much improved ease of use; right-click context menus offer an intuitive way to control the environment. Many new interface objects and common dialogs give programmers a richer set of building blocks for applications.

Windows 95 brings significant improvements to the Windows architecture including a true 32-bit API, protected address spaces for native 32-bit apps, preemptive multitasking, application threads, and increased use of virtual device drivers. There are significant compromises in the memory-protection model to achieve compatibility with existing 16-bit applications and 16-bit device drivers. But in practice, stability appears better than in Windows 3.1x.

PERFORMANCE Windows 95 offers surprisingly impressive performance. On slower systems limited to 4MB of RAM it comes close to or occasionally surpasses Windows 3.1x, depending on the operation. On faster systems with more memory, it remains very competitive in single-tasking, multi-tasking, and OLE tests. We recom-

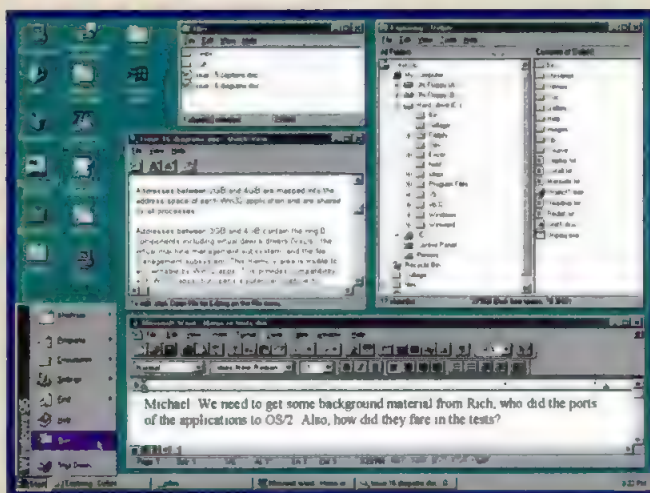
mend 8MB of RAM to achieve adequate performance.

COMPATIBILITY Although we encountered a few hitches, Windows 95 installed with reasonable ease on a broad range of test hardware and peripherals. It ran the vast majority of standard 16-bit Windows apps without problems.

Bundled applications. *Back-up, Briefcase, Calculator, CD Player, Character Map, Clipboard Viewer, Defrag, Dial-up Networking, Direct Cable Connect, DriveSpace, games, Hyperterminal, Net Watcher, Paint, Phone Dialer, Quick View, Scan Disk, screen savers, System Monitor, System Resource Meter, WordPad.*

Bundled network clients and protocols. *Microsoft Exchange client, Microsoft Network client, Novell NetWare 3.x and 4.x, IPX/SPX-compatible protocol, Microsoft DLC, NetBEUI, TCP/IP*

Estimated street price. Windows 95: upgrade, \$109 (available on CD-ROM or floppy disks); full version including bootable disk, \$209 (the full version is available on floppy disk only; certain components—including Quick View, System Monitor, administration tools, full driver sets, on-line Windows 95 Resource Kit, and miscellaneous utilities—are available on the CD-ROM version only).



The Windows 95 shell borrows concepts from other operating systems but brings a high gloss and great usability to the whole.

Windows 95 is here. And it's really terrific.

Except for one thing: it doesn't include any anti-virus protection. And your old anti-virus software won't work in Windows 95 either. But thousands of old viruses will.

So that leaves you with a choice. Do nothing and hope you never come across an infected floppy or download an infected file. Or buy a new anti-virus software product that

from the viruses everybody already knows about.

But also from the new viruses created every day.

What's more, you get all this ironclad



DETECTION, PREVENTION, DESTRUCTION. IF YOUR ANTI-VIRUS SOFTWARE DOESN'T HAVE ALL THREE, YOU'LL BE COMPLETELY EXPOSED TO VIRUSES IN WINDOWS 95.

can work in this new environment.

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Norton AntiVirus for Windows 95 is NCSA certified to detect 100% of the viruses found in circulation. And recent independent tests* conclusively demonstrate that Norton AntiVirus for Windows 95 detects and destroys as many or more known viruses as any other anti-virus product around.

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WINDOWS 95 COMPLIANT
Full 32-bit application. Supports long file names and Universal Naming Conventions.

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Virtual device driver unobtrusively checks for viruses in the background. Ensures backups and files transferred are virus-free.

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Provides ironclad virus protection without affecting productivity.
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proved. Windows 95 includes a built-in client for NetWare 3.x and 4.x networks as well as for Windows NT servers. It also includes native support for IPX/SPX, NetBEUI, and TCP/IP protocols. The last provides the protocol to connect you to the Internet, although better software for Internet connections, including a Web browser, is part of Microsoft Plus! Windows 95 lets you connect to another computer directly via cable and includes basic remote-access features for dialing into Window NT's Remote Access Server, NetWare Connect, or Shiva's dial-up servers. It also supports Microsoft's Telephony API (TAPI), designed to let your machine work in conjunction with your telephone for such features as logging phone calls or working as an answering service (these applications await third-party software).

In testing, Windows 95 performed quite well with both new apps and Windows 3.x apps, though Windows for Workgroups was faster at many disk-based operations. But on machines with 8MB or more, its performance was comparable to or better than previous versions of Windows. Its performance was superior in most cases to OS/2 running Windows apps, and far superior to that of Windows NT.

Microsoft has made many trade-offs with Windows 95. But for most users with at least 8MB of memory, upgrading to Windows 95 is a great choice. You'll find a better user interface, better performance, better multitasking, strong backward compatibility, and the ability to run a large number of new applications.

OS/2 WARP CONNECT 3.0

OS/2 is the OS that was supposed to be dominant by now. When IBM and Microsoft introduced OS/2 back in 1987, both positioned it as the logical successor to DOS. After a 1990 rift between the two, Microsoft moved ahead with Windows, and IBM took control of OS/2.

Since then, OS/2 has improved dramatically in quality, adding both features and stability. From its beginning, it was designed as a preemptively multitasking, multithreaded OS. OS/2 also offers far better memory protection, so that one ill-behaved application rarely brings down the entire system.

IBM's OS/2 Warp Connect Version 3

QUICK TAKE OS/2 Warp Connect is a network-enabled variant of OS/2 Warp, the operating system IBM positions as a robust alternative to Windows 3.1 and DOS. Its powerful Workplace Shell pioneered a fully object-oriented interface on the PC, complete with folders, icons, a true desktop, context menus, and extensive drag-and-drop support.

OS/2 Warp's 32-bit architecture resembles that of Windows 95, but it is generally better protected from crashes. It can preemptively multitask native OS/2 apps and run 16-bit Windows in either shared or separate protected Windows sessions. Its support for DOS applications is unparalleled among advanced operating systems. OS/2 Warp is not designed to support real-mode device drivers, and finding native OS/2 drivers remains problematic.

PERFORMANCE Tested on an 8MB system, OS/2 Warp Connect didn't exactly shine, but was broadly competitive at running 16-bit Windows applications. On 16MB systems, it was generally able to outperform Windows NT. On a 4MB system, the minimum recommendation for non-networked versions of OS/2 Warp, its scores were poor; clearly 8MB are required.

COMPATIBILITY Of the four operating systems we evaluated, OS/2 Warp proved the most challenging and unin-

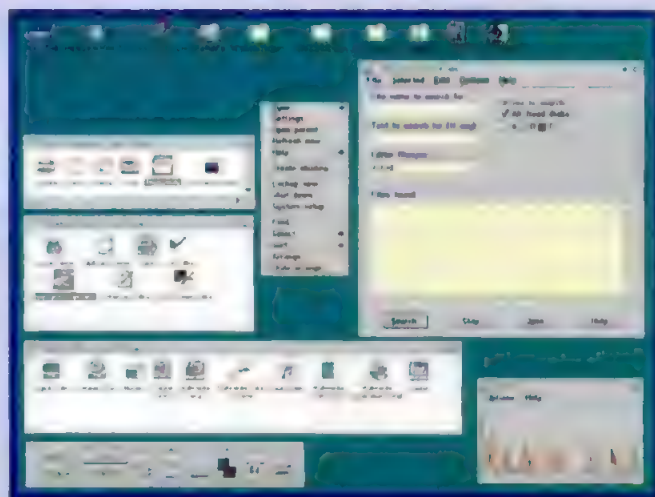
tuitive to install on our test hardware. Its out-of-box support for video cards was good, but we encountered some trouble finding workable drivers for some sound cards and CD-ROM drives. Bundled support for network cards was also mixed. Most 16-bit Windows software worked without a hitch, and support for OLE was solid. On some systems, we did encounter problems with the Windows Notes 3.31 client.

Bundled applications. *Clipboard Viewer, Enhanced Editor, Icon Editor, LaunchPad, OS/2 System Editor, Picture Viewer, Pulse, Seek and Scan Files.*

BonusPak for OS/2 Version 3. *CompuServe Information Manager for OS/2, FaxWorks for OS/2, HyperAccess Lite for OS/2, IBM Internet Connection for OS/2, IBM Multimedia Viewer, IBM Person to Person for OS/2, IBM Works, Video IN for OS/2.*

Bundled network clients and protocols. *IBM Peer for OS/2, IBM OS/2 Lan Requester 4.0, Novell NetWare Client Version 2.11 for OS/2, LAN Distance Remote 1.11, IBM Internet Connection for OS/2, Gopher, FTP, telnet, TCP/IP for OS/2 Version 3.0.*

List price. *IBM OS/2 Warp Connect Version 3 Blue Spine (with WIN-OS/2): \$299; IBM OS/2 Warp Connect Version 3 Red Spine (for Microsoft Windows): \$165.*



OS/2's impressive Workplace Shell pioneered the object-oriented interface that is now becoming standard on the PC.

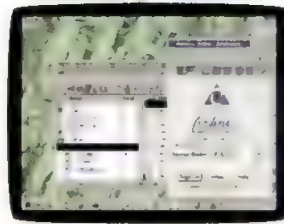
Congratulations! You're the proud owner of Microsoft's Windows 95 operating system. Working on a PC has never been easier.

Now try these ten easy exercises and see how you can work even better and faster in Windows 95 with the all-new Norton Navigator.[™]

CLICK. CLICK. CLICK. CLICK. **1.** First, copy a file from one directory to another. Okay, now copy another file. On average, it takes about eleven steps per file. Now copy a file with Norton Navigator.

5. Try a word search for "profits" or any other text string within files. It's at least ten times faster on average with Norton Navigator. No matter how many files you have. Or how big they are. In fact, the bigger the files, the more time you'll save.

6. Save another minute every time you delete, move, zip, or encrypt from



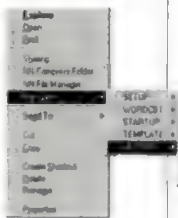
9. With Norton Navigator, you can create a different desktop for each project. So you can find your work more easily. And save even more time.

10. Windows 95 supports long file names for all of your new 32-bit applications. Norton Navigator supports long file names

THE TOP 10 REASONS WHY NORTON NAVIGATOR USERS WORK FASTER IN WINDOWS 95.

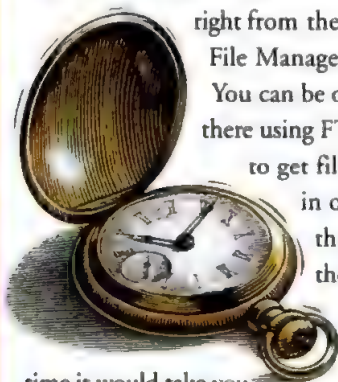
Mission accomplished. One step.

2. Opening a folder in Windows 95 takes a full five clicks of your trusty mouse. But with Norton Navigator, you can open any folder with just one simple click.



3. Compress a file. Our built-in PK-Zip compatible compression saves you a minute every time.

4. Use Norton Navigator to plug into your Internet connection right from the File Manager. You can be out there using FTP to get files in one third the



time it would take you with a separate application.

any application's Open or Save dialog box. (Are you keeping count?)

7. One click is all it takes to access recently opened files or folders from any application. Now isn't that better than wading through folders?

8. Launch your favorite files, folders, or applications simply by pushing a button on the Norton Taskbar. No more going up and down to and from the Start menu over and over again.

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Norton FastFind performs specific text string searches at least ten times faster than Windows 95.



for most 16-bit applications, too. So you'll never again have to remember what "billgbox" means.

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If you own Norton Desktop, PC Tools, XTree, or Norton Commander, get your \$39.95 trade-up edition of Norton Navigator for Windows 95 today. To purchase, visit your software store or call us at 1-800-450-9760 ext. 9171.



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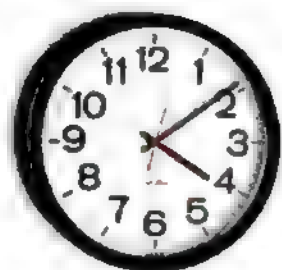
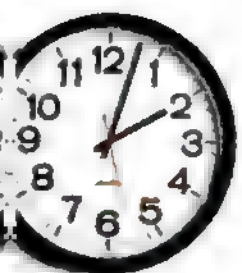


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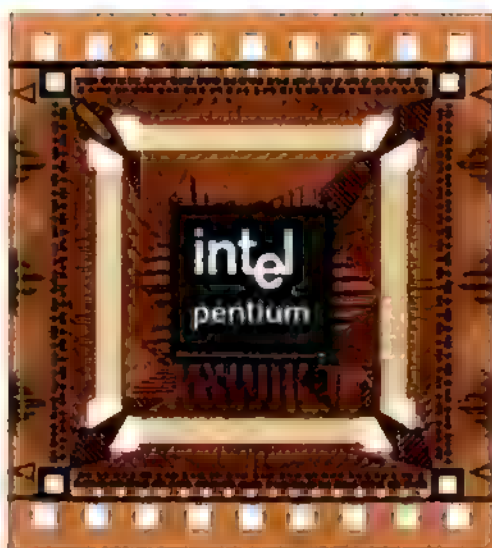
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The biggest change to OS/2 came with Version 2.0 in 1991, the first all-IBM release. This moved the product to a largely 32-bit code base and added the Workplace Shell. This object-oriented user interface has folders and objects, supports a broad range of drag-and-drop operations, and lets you create shadows (aliases). Many of these Workplace Shell features rest on IBM's System Object Model (SOM), a key part of the OpenDoc specification for building distributed, compound documents.

Late last year, IBM introduced OS/2 Warp 3, adding a new name as well as new features designed to bring OS/2 further into consumer and small-business markets. OS/2 Warp took the basic OS/2 2.1 functionality and added a number of new features and better support for peripherals. From a user-interface standpoint, it introduced a variety of new color schemes and better looking icons as well as a Launch Bar, a floating palette of icons that you can use to launch apps.

More importantly, it added a variety of new applications. Key among these was the Internet Access Kit, software that links OS/2 users to the Internet through IBM Advantis or another Internet provider. This made OS/2 Warp the first major PC operating system to bundle Internet access as well as TCP/IP support. OS/2 Warp also includes IBM Works, a highly integrated productivity suite that also takes advantage of SOM.

The initial OS/2 Warp release provided support for 16-bit Windows applications by using Windows code already installed on the user's system. A later version called the Full Pack included Win-OS/2, IBM's licensed version of the Windows 3.x code. Win-OS/2 works quite well; it's nearly indistinguishable from Windows 3.x, except that versions of OS/2 with Full Pack tend to run Windows apps slightly faster than versions that use existing Windows.

For networked business customers, IBM recently introduced OS/2 Warp Connect. This release includes peer services, which let you share files and directories with other users, either using its peer-to-peer networking features or a larger network. It also includes a requester for NetWare. While the NetWare requester provides basic login functionality to NetWare 3.x and 4.x servers, it ap-

Microsoft Windows NT Workstation 3.51

QUICK TAKE This workstation operating system has all the robustness of a server OS. The Windows NT architecture was designed to provide maximum stability and robustness. Native applications are preemptively multitasked in protected memory spaces, and Ring 3 system DLLs are protected from applications through an elaborate client/server scheme. Ring 0 code is protected by hardware-enforced supervisor privileges. This entails a fair amount of system overhead but offers stability comparable to many Unix servers. Windows NT will not work with real-mode device drivers. Its rich built-in networking features including a NetWare client services and TCP/IP.

Windows NT Workstation uses essentially the same interface as Windows 3.11, although a Windows 95-style user interface is already being distributed in a beta version. In addition to the usual Windows applets, Windows NT includes a big arsenal of administrative tools.

PERFORMANCE Considering the extra overhead entailed by its heavily protected architecture, Windows NT Workstation performs very well. On a 16MB system, its test scores come close to those of less heavy-weight environments, and on a 32MB system, its performance is extremely competitive (we recommend at least 16MB for ad-

equately performance). Still, a decision to adopt Windows NT is tough to justify on performance grounds alone, considering its cost and system requirements.

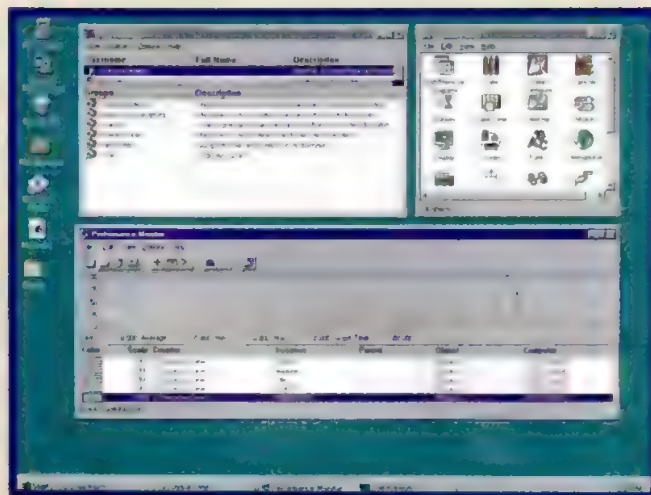
COMPATIBILITY Windows NT Workstation provided a wide selection of device drivers for our test systems and peripherals. Compatibility with 16-bit Windows applications was generally good; exceptions were erratic behavior from the Lotus Notes 3.3 client and incompatibility with Adobe Type Manager.

Bundled applications. *Calculator, Cardfile, CD Player, Character Map, Chat, Clock, Media Player, Notepad, Object Packager, Paintbrush, Recorder, Sound Recorder, Terminal, Write.*

Bundled administrative tools. *Backup, Disk Administrator, Event Viewer, Performance Monitor, Services, User Manager, Windows NT Diagnostics.*

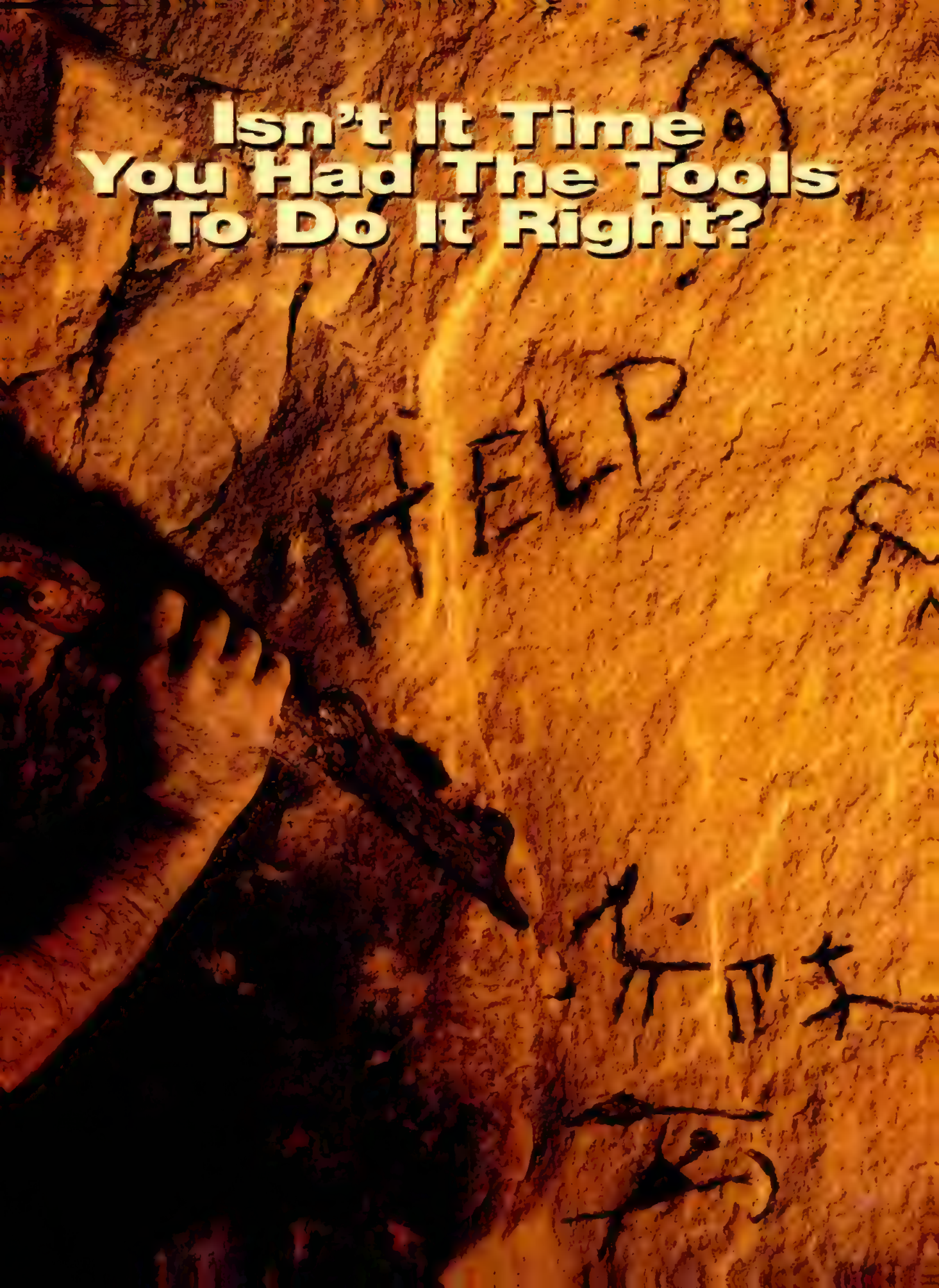
Bundled network clients and protocols. *Client Service for NetWare, FTP Server, FTP, telnet, SLIP, PPP, other TCP/IP connectivity applications, Remote Access (client and server), AppleTalk, DLC, NetBEUI, IPX/SPX-compatible protocol, TCP/IP.*

Estimated street price. *Microsoft Windows NT Workstation 3.51: \$319. Standard packaging is on CD-ROM, and floppy disk versions are available.*



Windows NT 3.51 ships with a powerful set of utilities well in keeping with its status as a workstation platform.

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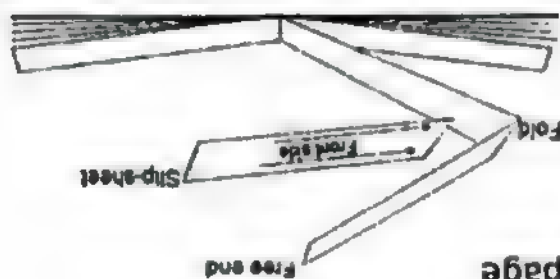
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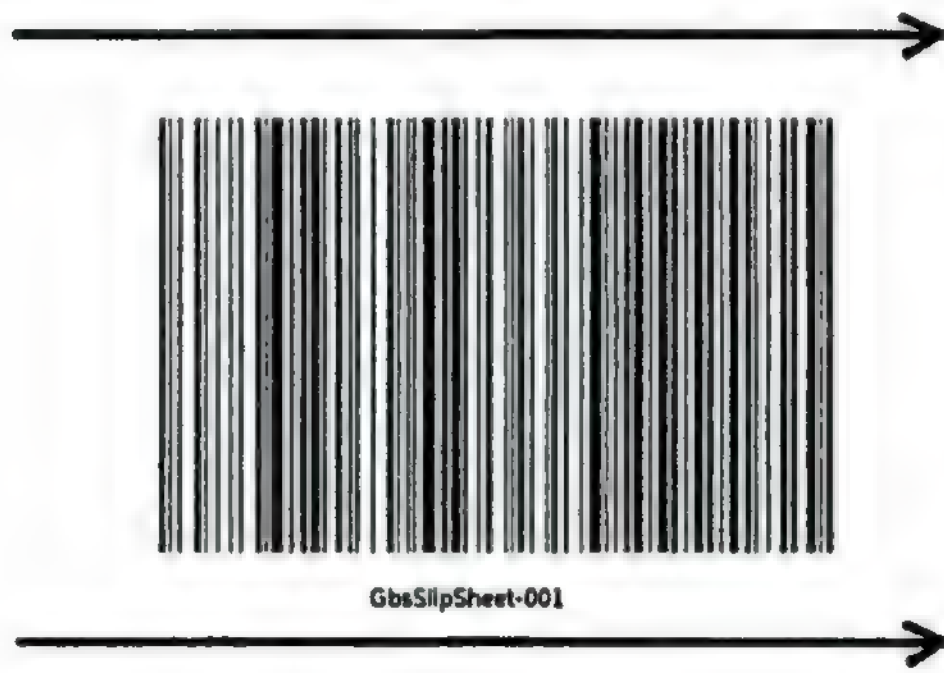
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 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet

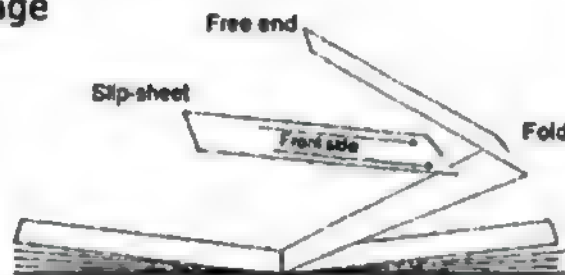
Inverted Foldout slip-sheet



Folded edge of the page

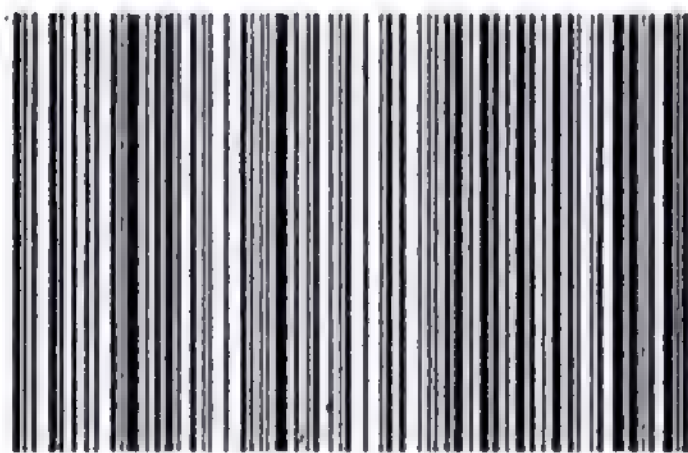
Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



1. Follow instructions on the other side

Inverted Back



GbsSlpBack-001B

Back

1. Follow instructions on the other side

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Magazine, the Pentium™ processor-based Pantera line is now boosted even further with the addition of EDO DRAM, synchronous burst SRAM cache options and CPU

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pears little changed from the 16-bit Novell Requester introduced in 1991.

Because it uses your existing Windows or IBM's licensed code, OS/2 is very compatible with most Windows applications. It can run them either in a shared address space as in Windows 3.1x or in a protected address space with its own copy of the Windows code. A similar option lets you configure individual DOS sessions for individual DOS programs, giving you unparalleled control over running DOS games. OS/2 lets you work with DOS device drivers in individual DOS sessions,

though you can't use these for OS/2 or Windows apps. One of the biggest remaining complaints about OS/2 Warp is the difficulty of getting it running properly with your devices. If an OS/2 device driver is not available for your CD-ROM, graphics board, or sound system, you may be unable to get those devices to work.

The other big complaint about OS/2 is the relative scarcity of native applications (the fact that OS/2 runs Windows 3.x software so well has proved to be a two-edged sword). OS/2 Warp Connect will not run 32-bit programs developed for Windows

95 and Windows NT. Instead, IBM is stressing a new set of APIs that make it easier for developers to port their 32-bit Windows applications to OS/2.

In our performance tests, OS/2 was typically slower than Windows 3.1 or Windows 95 at running existing Windows applications, though faster than Windows NT. It was notably slower in operations such as OLE, but performed comparably to Windows 95 on most multitasking operations using native apps. According to IBM, OS/2 Warp runs on machines with 4MB of RAM while OS/2 Warp Connect

Bundled Operating Systems: New Offerings from the Top 35 Vendors

With the exception of IBM (whose PCs each offer a dual boot of OS/2 and Windows), all of the leading PC vendors currently bundle Windows 3.1 or Windows for Workgroups 3.11 with most of their new machines. These staple operating systems, however, will become less prevalent once Microsoft releases Windows 95. Here are the operating systems that the top 35 PC vendors (by revenue) plan to bundle with their machines after Windows 95 hits the market.

■ = YES □ = NO

Company	Location	Telephone	Microsoft Windows 3.1	Microsoft Windows for Workgroups 3.11	Microsoft Windows 95	OS/2 Warp 3.0	Microsoft Windows NT
Acer America Corp.	San Jose, CA	800-733-2237	Undecided	Undecided	■	Undecided	Undecided
Advanced Logic Research Inc.	Irvine, CA	800-648-7822	□	□	■	□	Optional ¹
AMS Inc.	Irwindale, CA	800-886-2671	□	On request	■	□	□
AST Research Inc. (business and mobile)	Irvine, CA	800-876-4278	□	■ ³	■	□	□
AST Research Inc. (home) ²	Irvine, CA	800-876-4278	□	□	■	□	□
AT&T Global Information Solutions (desktop, mobile business)	Dayton, OH	800-447-1124	■	■	■	□	□
AT&T Global Information Solutions (retail)	Dayton, OH	800-447-1124	□	□	■	□	□
Compaq Computer Corp.	Houston, TX	800-345-1518	Undecided	Undecided	■	Undecided	Undecided
CompuAdd Corp.	Austin, TX	800-627-1967	□	On request	■	On request	On request
CompUSA	Dallas, TX	800-266-7872	Optional ¹	Optional ¹	■	Optional ¹	Optional ¹
Comtrade	City of Industry, CA	800-969-2123	□	On request	■	Optional ¹	Optional ¹
Dell Computer Corp.	Austin, TX	800-613-3355	Undecided	Undecided	■	Undecided	Undecided
DFI Inc.	Sacramento, CA	800-808-4334	On request	On request	■	On request	On request
Digital Equipment Corp.	Acton, MA	800-722-9332	□	■ ³	■ ³	□	□
DTK Computer Inc.	City of Industry, CA	800-289-2385	On request	Optional ¹	■	Optional ¹	□
Epson America Inc.	Torrance, CA	800-289-3776	■	□	■	□	□
Everex Systems Inc.	Fremont, CA	800-821-0806	□	Optional ¹	■	□	Optional ¹
Gateway 2000 Inc.	North Sioux City, SD	800-846-2000	□	Optional ¹	■	□	□
GST/Micro City	Carritos, CA	800-567-2764	□	On request	■	□	□
Hewlett-Packard Co.	Palo Alto, CA	800-752-0900	□	□	■	□	□
IBM Corp.	Armonk, NY	800-426-3333	Undecided	On request	Undecided	■	On request
Insight Enterprises Inc.	Tempe, AZ	800-729-0770	□	On request	■	□	□
IPC Technologies Inc. (Austin Direct)	Austin, TX	800-849-8681	□	On request	■	On request	□
Leading Edge Products Inc.	Westborough, MA	800-874-3340	Undecided	Undecided	Undecided	Undecided	Undecided
Memorex Telex Corp.	Irving, TX	800-944-4455	■	■	■	■	■
Micron Computer Inc.	Nampe, ID	800-438-3343	□	Undecided	■	□	Optional (\$245)
MidWest Micro	Fletcher, OH	800-445-2035	On request	On request	■	□	□
Mitsuba Corp.	La Verne, CA	800-648-7822	□	□	■	Optional ¹	Optional ¹
NEC Technologies Inc.	Boxborough, MA	800-632-4636	Undecided	Undecided	Undecided	Undecided	Undecided
Packard Bell Electronics Inc.	Westlake Village, CA	800-733-5858	Undecided	Undecided	■	Undecided	Undecided
Samsung Electronics America Inc.	Ridgefield Park, NJ	800-933-4110	■	□	■	□	□
Texas Instruments Inc.	Temple, TX	800-848-3927	□	Optional ¹	■	□	□
Toshiba America Information Systems Inc.	Irvine, CA	800-334-3445	□	□	■	□	□
Unisys Corp.	San Jose, CA	800-448-1424	□	■	■	■	■
USA Flex Inc.	Bloomington, IL	800-872-3539	Optional ¹	Optional ¹	■	Optional ¹	Optional ¹
Zenith Data Systems	Buffalo Grove, IL	800-582-0524	Undecided	Undecided	■	Undecided	Undecided
ZEOS International Ltd.	Minneapolis, MN	800-554-7172	□	■	■	□	Optional (\$329)

1 The price is yet to be announced 2 These plans will go into effect once the AST fall line of home PCs is released
3 When a machine is first booted, the user will choose either Windows for Workgroups 3.11 or Windows 95, and the other will then be deleted

Extras and Add-Ons: A Comparative View

By Edward Mendelson

The latest PC operating systems offer far more in the way of bundled applications and utilities than any of their predecessors. These may be communications programs, Internet access tools, powerful system utilities, or even entire miniature application suites. OS/2 Warp leads the applications field with a high-powered, integrated suite that comes in its free Bonus Pack add-on. Windows 95 doesn't try to match OS/2 Warp's depth of applications—not even with its \$50 Microsoft Plus! add-on—but many of Windows 95's new applets still surpass standalone programs you bought a few years ago. Here's a look at what each OS offers by way of bundled extras and add-ons.

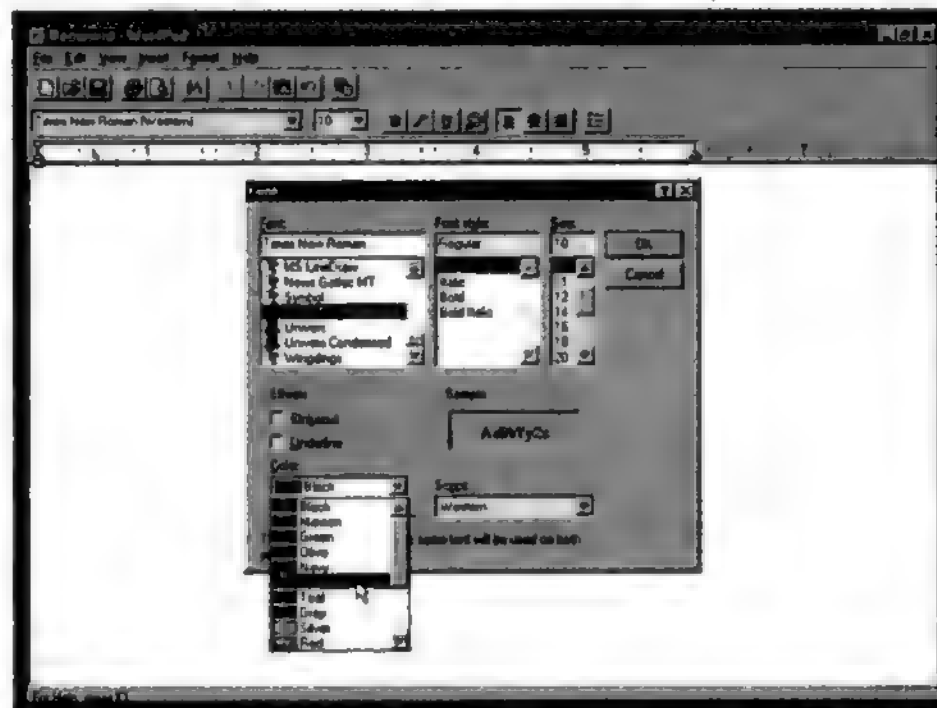
WINDOWS 3.1X

Both Windows 3.1 and Windows for WorkGroups 3.11 come with essentially the same basic applets you've used for years: Calculator, Calendar, Cardfile, Media Player, Notepad, Paintbrush, Sound Recorder, Terminal, Write, a macro recorder, a clock, and so forth. The ClipBook in Windows for Workgroups is an enhanced version of the original Clipboard viewer.

WINDOWS 95 AND MICROSOFT PLUS!

Windows 95 improves on some these existing Windows applets, adds many impressive new ones, and drops a few duds like Calendar and Cardfile. As before, Windows comes with two editors. Notepad is unchanged from its Windows 3.1 version and still won't edit

files larger than 32K. Write has been replaced by the far superior WordPad, which offers layout options including automatic first-line indents and bulleted lists. WordPad saves in three formats: Microsoft Word 6.0, RTF, and text. It lets you drag text selections within a document and, more importantly, it supports OLE 2.0 drag-and-drop, so you



Windows 95's bundled WordPad is a sophisticated OLE 2.0 mini word processor.

can drag selected text from WordPad and drop it on the desktop, automatically creating a *scrap* document. You can open this later or drag it into any other application with the same OLE level.

Paint, the Windows 95 successor to Paintbrush, has turned into a somewhat more serious bitmap-editing program that comes with tools for skewing and stretching images. Paint still reads .PCX files, but it saves only in .BMP format.

The Windows Calculator looks better, and has squashed a bug that produced some mistaken sums but is otherwise unchanged. The Character Map

utility for finding nonkeyboard characters in your fonts is unchanged. Calendar and Cardfile are gone—although they're still on your system if you install Windows 95 over Windows 3.x. A new Briefcase utility provides basic directory synchronization between desktop and laptop, or server and workstation. System utilities include a disk defragmenter,

DriveSpace disk compression, and a backup utility that finally supports QIC tape as well as disks. The sophisticated System Monitor gives you a dynamic readout of many CPU, disk, and memory parameters, while the Resource Meter provides a quick check on available system resources.

The centerpiece of Windows 95's bundled communications facility is the Inbox icon that leads to Microsoft Exchange, a unified client for Microsoft Mail, Internet mail, CompuServe mail, Microsoft Network mail, and a basic fax utility. Internet access is

needlessly complicated until you buy the Plus! add-on, which comes with a strong Web browser and a wizard for setting up connections with third-party service providers. Windows 95 also ships with an entry-level version of Hilgraeve's HyperTerminal.

The Microsoft Plus! add-on package adds a System Agent event scheduler, desktop and screen enhancements, a slick 3-D pinball game, and an optimized version of DriveSpace that applies more compression than the version in Windows 95 itself. It also includes Internet Explorer, an Internet

requires at least 8MB. We think 8MB is a minimum and 16MB is preferable.

In many areas, such as multitasking and protection, OS/2 has been ahead of Windows 3.x and continues to be ahead of Windows 95. While it doesn't offer quite the stability of Windows NT, its system requirements are much less demanding. The user interface is an acquired taste, but the same is true for Windows 95. Once

you get past the installation hurdles, OS/2 provides a competitive environment for running DOS, Windows 3.x, or native OS/2 applications. We hope that new porting tools will enlarge OS/2's currently limited pool of native applications.

MICROSOFT WINDOWS NT

Microsoft Windows NT Workstation 3.51 is designed as a high-end personal

operating system, with more sophisticated features and higher system requirements than its competitors. It requires a bare minimum of 12MB of RAM and can take up to 75MB of hard disk space to install. Like OS/2 Warp and Windows 95, it is a 32-bit multitasking, multi-threaded operating system but adds important security features, a robust new log-based file system, and portability to

access package that can be used with third-party service providers or Microsoft's upcoming World-Wide Web access through the Microsoft Network.

OS/2 WARP AND THE BONUS PACK

When you buy a copy of OS/2 Warp, a copy of the BonusPak comes in the box. This collection of utilities includes IBM Works, a tightly integrated application suite; the IBM Internet Connection for OS/2; Hilgraeve's HyperAccess Lite for OS/2; a basic version of SofNet's FaxWorks for OS/2; and a CompuServe access program.

IBM Works is a marvel of integration and efficiency. The suite consists of a word processor, spreadsheet, database, charting applet, contact list, and full-featured PIM, each with drag-and-drop connections to the others and each with an impressive feature set. The word processor uses data fields from the PIM or contact list when you run a mail merge and supports paragraph styles, keyboard macros, and tables. The spreadsheet, which includes a table-lookup feature, has a wider range of math functions than usually found in integrated packages. The chart applet offers a convenient direct-entry window when you don't need all the features of the spreadsheet. The database supports image fields, and a report writer creates columnar output from any dBASE-compatible database. The whole package achieves a level of elegance and power that makes it a serious rival to some Windows-based integrated suites.

The communications packages, in contrast, offer a mixed bag of wildly

different interfaces and, because OS/2 lacks any counterpart to the Telephony API (TAPI) in Windows 95, you have to set up all the communications packages separately. You can get instant Internet access if you use IBM as your service provider, but if you want to use an alternative provider, prepare to spend a few hours struggling with IBM's underdocumented log-on script language. Once you get connected, IBM's suite of built-



IBM Works is a tightly integrated, surprisingly full-featured productivity suite.

in Internet tools—including Web browser, Gopher, FTP, and others—are extremely usable, and OS/2's underlying object orientation makes it possible to drag Internet addresses to the desktop to create icons that jump to those sites later (a feature now imitated in Windows 95).

The other communications packages are powerful but less successful. FaxWorks suffers from a confusing interface and limited options. HyperAccess Lite lacks the elegance of the more up-to-date version that comes with Windows 95. The Bonus Pack also comes with a multimedia viewer, a

basic video-capture applet.

If you don't install the Bonus Pack, OS/2 Warp gives you three text editors: a plain-text editor to optionally display your choice of fonts, a forbidding programmer's editor, and a miniature character-mode editor. OS/2 Warp's picture viewer doesn't display any standard graphics formats but can be used as a primitive print-previewer since it displays spooled print files. OS/2 Warp lacks a keystroke recorder, but its REXX batch language is extremely powerful and relatively easy to learn. Other applets in the basic OS/2 package are an icon editor, a Find Objects search utility, a Seek and Scan Files module, and Pulse, a CPU utilization monitor.

WINDOWS NT WORKSTATION 3.51

Windows NT includes the same basic applet set as Windows 3.x, but it also bundles a set of high-end tools in keeping with its character as a workstation OS. These include a backup facility with tape support; Disk Administrator for managing disk partitions, striping, and mirroring; Event Viewer, which lets you browse a detailed log of system events and errors; and User Manager, which lets you manage user and group security. The Performance Monitor, a higher-tech version of Windows 95's System Monitor, gives you a customizable running readout of CPU and system activity. The Services utility lets you start, stop, and monitor system services and application services. While Windows NT can't match the productivity applets in OS/2 Warp or Windows 95, its utilities go far beyond both in scope and power.

non-Intel platforms. Its basic architecture offers more protection than any of the competitive systems.

Under Windows NT, operating-system services run in a separate address space, as does each individual application written to the Win32 API. Existing 16-bit Windows applications can be run in a protected address space for better protection or in a shared space if re-

quired for compatibility. In addition, Windows NT can run 16-bit OS/2 character-mode applications and Posix-compliant applications. As under OS/2, each DOS application can run in its own virtual machine; Windows NT provides support for DOS-environment features such as memory-resident applications and expanded memory. It cannot run DOS device drivers, including drivers for things

like fax boards, sound boards, scanners, or terminal emulation.

Windows NT's architecture is more robust than any of the other alternatives in this evaluation. It gracefully recovered from every attempt we made to crash it. Enforcing this level of protection does impose additional overhead and memory, resulting in slower performance in most situations.

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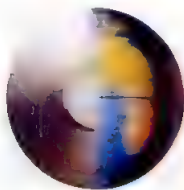
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Windows NT 3.51 is currently available for Intel, Alpha, MIPS, and PowerPC-based workstations, though applications do need to be recompiled to run under each architecture. Microsoft has plans for a minor upgrade, including the final version of the Windows 95 user interface, after the first of the year. A major upgrade called Cairo is now in the works for late 1996 or early 1997.

Windows NT's user interface is virtually identical to that of Windows 3.1, with the familiar File Manager—and Program Manager—based shell, common dialog boxes, and the same basic design and built-in applications. Like Windows for Workgroups, it includes peer services as well as clients for Microsoft Mail and Schedule +. In addition, it comes with a variety of administrative tools including backup, Event Viewer, Disk Administrator, and Performance Monitor, and offers remote access server (RAS) features, which let you remotely log on to a machine.

Many networking features are included in the bundle. Server capabilities are actually built into Windows NT Workstation, so you can share files, directories, or drives if you are logged on as a member of the Administrators or Power Users group. Windows NT offers support for multiple protocols, including IPX/SPX, TCP/IP, and NetBEUI as well as clients for Windows NT and NetWare networks. The NetWare requester, NetWare Link, is a client for NetWare 3.x and 4.x servers, though it does not yet support NetWare, Version 4.0, features such as NetWare Directory Services.

Installation was surprisingly easy on most of our test systems, though we did have to set up some network or sound cards manually. The program made adding new device drivers simple and was very clear about the drivers needed. In general, compatibility with existing software was good but not perfect.

Windows NT is the choice for users who want the greatest amount of stability and protection. While it hasn't had much application support in the past, the developers' move to Windows 95, with its near-identical API, means that problem is disappearing. It does require a powerful system, but it's a good choice for users who are willing to spend a bit more on their systems and who don't need DOS device support.

Your Next OS

Architectural Review

Low-level design features explain why OS/2 Warp, Windows 95, Windows NT, and Windows 3.1 differ so significantly.

By Thomas Mace

Today, it's easy to find fault with the Microsoft Windows 3.x architecture, which was laid down when 286 processors and small amounts of RAM were the norm. But it's also worth recalling what Windows 3.x brought to the PC: a sophisticated GUI, transparent memory management, scaleable fonts and a unified imaging model, multitasking, and 32-bit virtual device drivers (VxDs)—just to name the most important contributions. Here, we look at the architectural pros and cons of Windows 3.1x and the 32-bit operating systems poised to succeed it.

WINDOWS 3.1X

Fundamentally, Windows 3.1x has a 16-bit design. Its kernel, most major system components, and native applications are largely implemented in 16-bit code. (Its little-used Win32s API supports 32-bit apps, but it doesn't support threading.)

All native Windows 3.1x applications and all of Windows' own system DLLs

are mapped into a common segmented virtual address space, 4GB in size. All these components are visible to (and often writable by) each other. At the bottom of this address space, usually below the 1MB mark, are the real-mode device drivers that provide an interface to peripheral subsystems such as video cards

or printers. Windows 3.11 does use VxDs for the file system, providing a protected-mode path to disk.

This stripped-down design provides a very small *working set*, (the application and system code that must be loaded for any given task), so Windows

3.1x can run well on systems with limited RAM. It also allows for very efficient code execution, since programs can call API functions from within their own memory space. Its drawback is a lack of protection when something goes wrong. Since programs and system components are visible to each other, a buggy program can easily overwrite memory belonging to another process. While Win-



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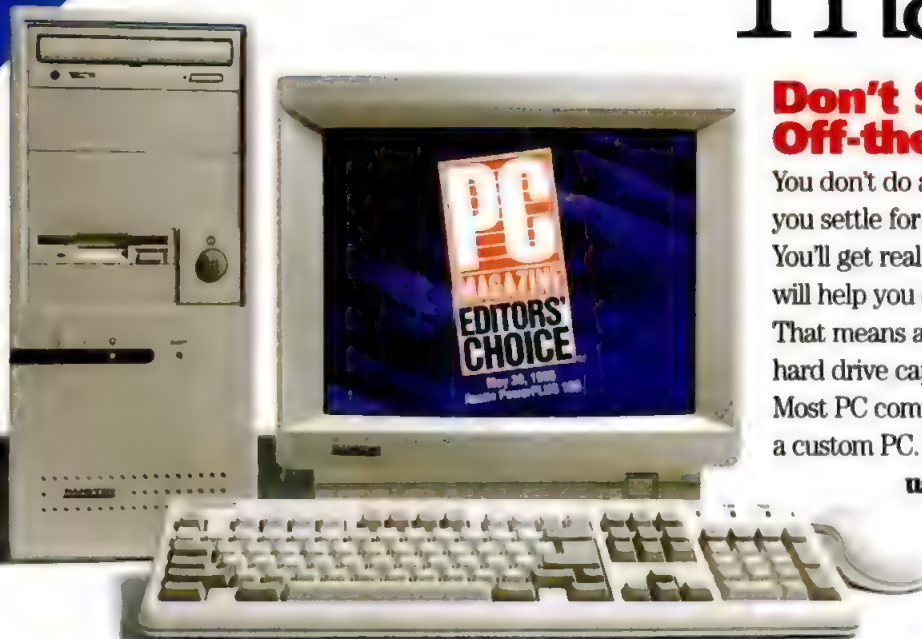
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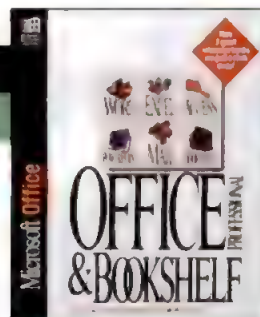
Tech Support Average Response Time

Based on average of desktop and notebook scores.

Source: July 1995 PC Magazine



* IPC Technologies, Inc. internal reporting indicates an average response time of under 2-minutes. Industry average is 8.7 minutes. Actual times may vary.



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dows 3.1x is capable of recovering from some of these general protection faults (GPFs), the outcome is often a system-wide crash.

Windows 3.1x runs multiple applications through a simple scheduling mechanism called cooperative multitasking. Under this system, each application is responsible for voluntarily giving up control when it checks its message queue and

finds it empty. But if an application fails to check its message queue, either because it is busy or because it hangs, other applications are kept from their share of OS resources.

Another frustration Windows 3.1x users have long faced is the limited size of GDI and USER resources. These constraints are due to the fact that the GDI and USER system DLLs use several 64K

heaps for storing a variety of arcane data structures created by running applications. When these small heaps fill up, you see an out-of-memory error even with plenty of free memory left.

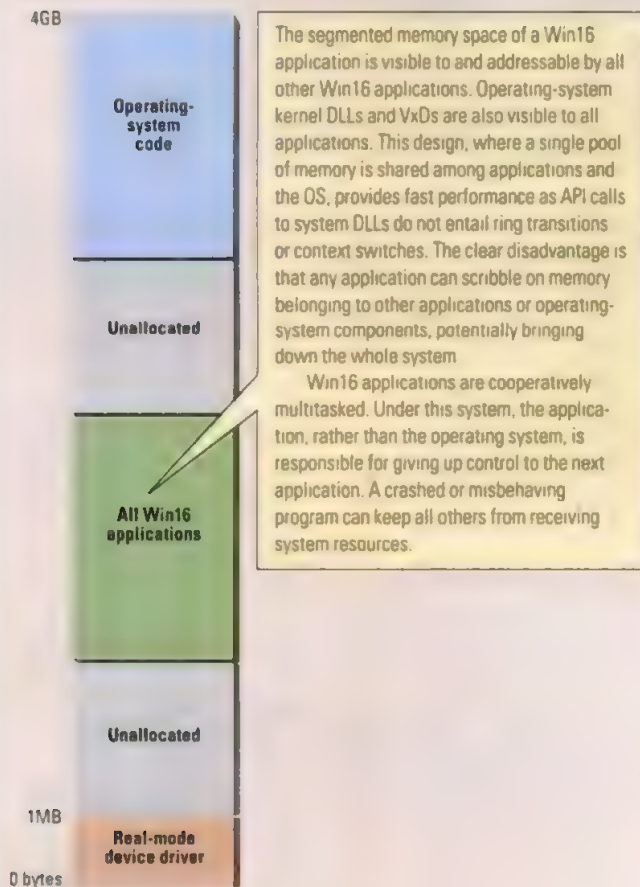
WINDOWS 95

Windows 95 represents an evolutionary development of Windows 3.1x rather than a clean break with the past. While it

Comparative OS Architectures: *The memory model of each operating*

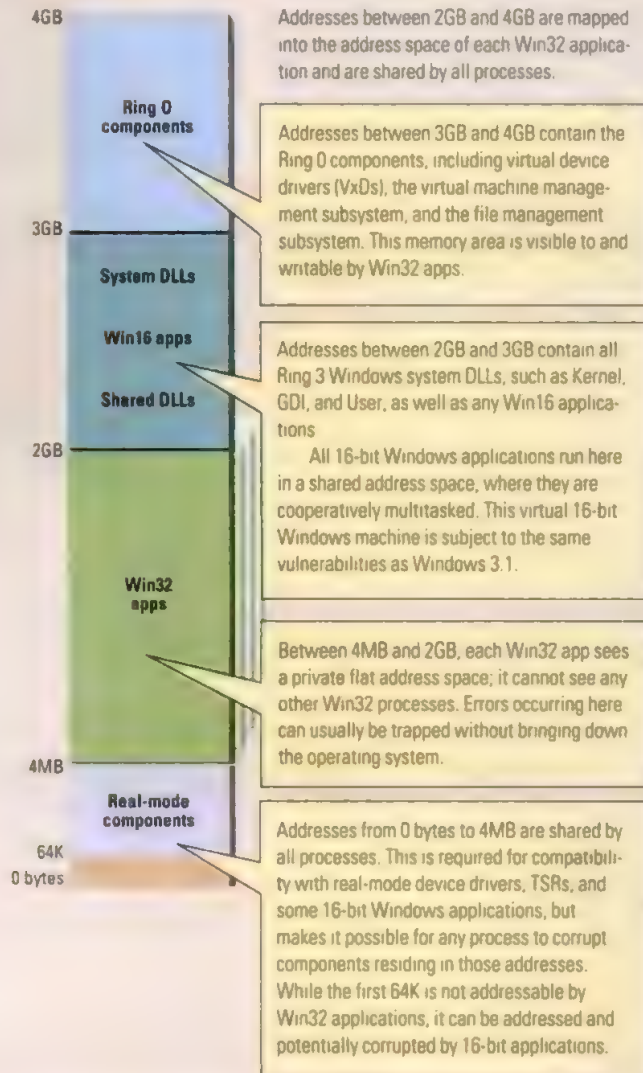
WINDOWS 3.1

Windows 3.1 embodies trade-offs between performance and protection that hark back to the days of the 286. While it provides good performance for Win16 applications, DOS applications, real-mode device drivers, and virtual device drivers (VxDs), it offers almost no protection against badly behaved applications.



WINDOWS 95

Windows 95 strikes a balance among performance, compatibility, and robustness. It offers fast execution of Win32, Win16, and DOS applications, and it can use real-mode device drivers. While it offers better crash protection than Windows 3.1, it remains vulnerable on several fronts.



brings many significant changes to the 16-bit Windows architecture, it also keeps some of its essential features. The result is a hybrid OS, one that can run 16-bit Windows and DOS legacy apps and older real-mode device drivers while supporting true 32-bit applications and 32-bit VxDs.

The most important improvements Windows 95 brings include native sup-

port for 32-bit multithreaded applications, protected address spaces, preemptive multitasking, far more extensive and efficient use of VxDs, and increased use of 32-bit heaps for storing system-resource data structures. Its most significant drawback is that it is still relatively unprotected from badly behaved applications.

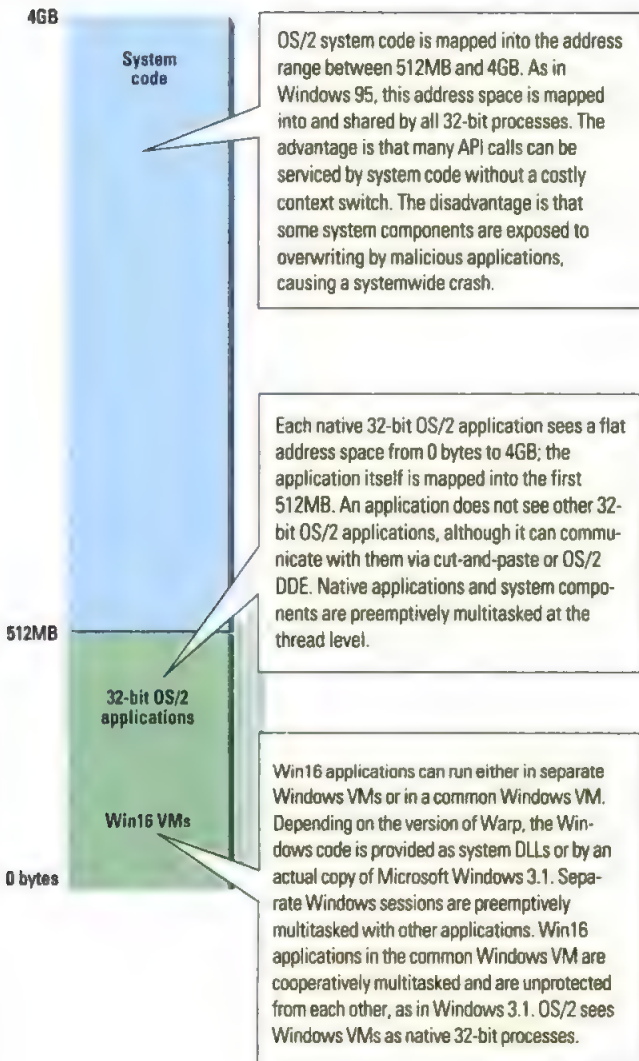
Each native Windows 95 application

sees a flat 4GB address space containing itself plus the Windows 95 system code and drivers. As far as each 32-bit application is concerned, it is the only application on the PC. The application code loads into this address space from the 4MB to the 2GB mark. Although 32-bit apps can't see each other, they can pass data to each other via the Clipboard, DDE, and OLE. All 32-bit applications

system as seen from the application's point of view.

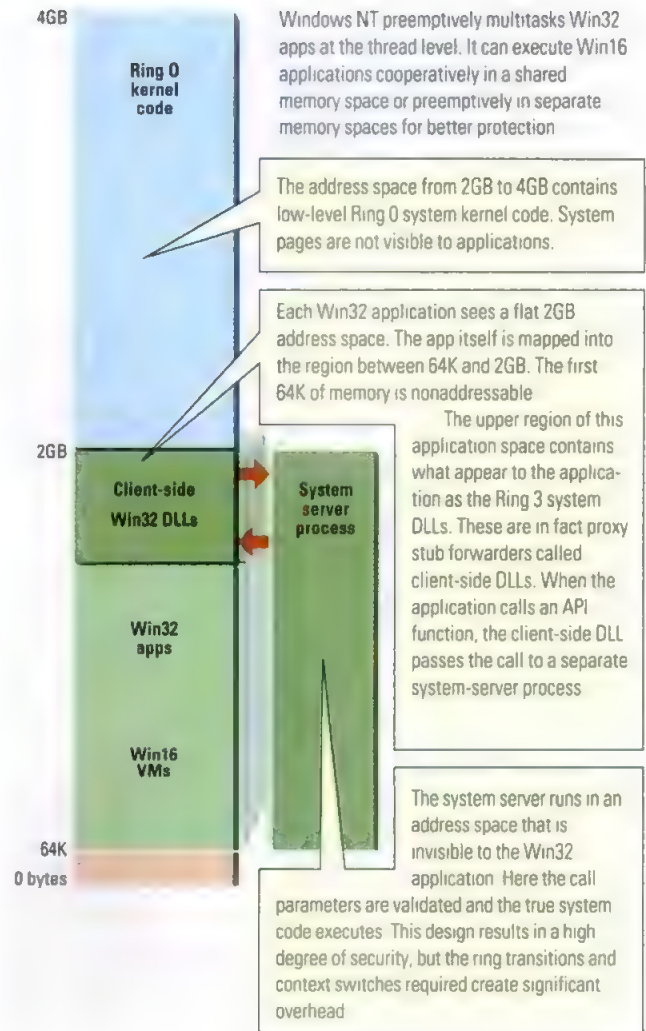
OS/2 WARP

OS/2 Warp offers good performance of native OS/2, 16-bit Windows, and DOS applications while delivering better crash protection than either Windows 95 or Windows 3.1. Because of this, however, it is not compatible with DOS and Windows device drivers. It does not support Win32 applications.



WINDOWS NT

Windows NT's client/server architecture offers significantly better crash protection than OS/2 or Windows 95. But you'll need a powerful PC with ample memory to get acceptable performance. Windows NT supports Win16 and DOS applications but does not support real-mode device drivers.



are preemptively multitasked on a per-thread basis. The thread scheduler, a part of the virtual memory management (VMM) system, distributes system time among the pool of current threads based on each thread's priority level and readiness to run. Preemptive scheduling offers far smoother and more robust multitasking than the cooperative method used in Windows 3.1x.

The Windows 95 system code resides above the 2GB mark. In the range of 2GB to 3GB are the Ring 3 system DLLs and any DLLs that are used by multiple programs. (Intel 32-bit processors offer four hardware-enforced protection levels named Ring 0 through Ring 3. Ring 0 is the most privileged.) Windows 95's Ring 0 components are mapped from 3GB to 4GB. These important, highly privileged pieces of code include the VMM subsystem, the file system, and VxDs.

The area of memory from 2GB to 4GB is mapped into the memory space of every 32-bit application so it is shared by all 32-bit apps on your PC. This design allows API calls to be serviced directly within the

application's address space, and it limits the size of the working set. The downside is compromised robustness. There is nothing to stop a buggy application from scribbling on addresses belonging to system DLLs, crashing the entire show.

The area from 2GB to 3GB also contains any 16-bit Windows applications you may be running. For compatibility reasons, these execute in a shared address space, where they can corrupt each other just as they can in Windows 3.1x.

The memory addresses below 4MB are also mapped into the address space of each application and are shared by all processes. This makes compatibility with existing real-mode device drivers possible, since they require access to those addresses. It also opens up another area of the memory map to malicious scribbling. The very bottom 64K of this address space is not addressable by 32-bit applications, in order to catch faulty pointers, but it is addressable by potentially buggy 16-bit applications.

Some Windows 95 system DLLs, USER and GDI in particular, still con-

tain 16-bit code. One unfortunate result of this is that USER's and GDI's 64K local heaps and their attendant system-resource limitations are still with us. Fortunately, Windows 95 did move a number of data structures into 32-bit heaps, making it far harder to run out of system resources than under Windows 3.1x. Another problem raised by 16-bit system code is the Win16Mutex effect. Since 16-bit system code is nonreentrant, only one thread can access 16-bit DLL functions at a time, potentially hobbling other processes that need access to the DLL in question.

OS/2 WARP

OS/2 Warp Connect 3.0 is architecturally similar to Windows 95 in many ways, though its design philosophy makes fewer compromises with 16-bit legacy code. The result is a better-protected OS than Windows 95 that can run OS/2, Win16, and DOS programs, but that is incompatible with 16-bit Windows device drivers. OS/2 Warp doesn't support 32-bit Windows apps.

Native 32-bit OS/2 applications see a



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4GB private address space. Application code is mapped into the range from 0 to 512MB while the OS/2 system code is mapped from 512MB to 4GB. This system code area is shared by all processes. Executing 32-bit apps do not see each other although they can communicate via cut-and-paste or OS/2 DDE. OS/2 Warp preemptively multitasks native applications on a per-thread basis.

This design provides many of the same benefits and drawbacks found in Windows 95. System resources are allocated smoothly, and calls to system APIs can be serviced without costly overhead, since the system DLLs are in the same address space as the calling application. The working set is also kept to a reasonable size, since multiple instances of system DLLs are not required. But protection is not guaranteed because badly behaved applications can still overwrite important system areas.

OS/2 Warp does go beyond Windows 95 in important ways, however. Problems with system-resource limitations are unknown, since OS/2 Warp does not use

64K heaps to store system DLL data structures. It also provides several services unknown to Windows including the System Object Model (SOM) and REXX, a powerful batch language used on a wide variety of IBM platforms.

In addition to hosting native OS/2 applications, OS/2 Warp can run 16-bit Windows apps. Depending on which version you buy, OS/2 Warp does this either by running a copy of Microsoft Windows 3.1 as a process under OS/2 or by running its own Win-OS/2 libraries. With either, you have the choice of running a Windows session for each Windows program or running all Windows programs in a shared address space. The latter approach may offer better compatibility but promises less stability, since it functions essentially like Windows 3.1x. OS/2 Warp can also run DOS applications in highly configurable, preemptively multitasked DOS virtual machines.

OS/2 was not architected to support real-mode device drivers, so your hardware devices must be natively supported by OS/2 drivers. The advantage to this ap-

proach is that OS/2 can fully protect the first 4MB of the application memory map, an area where Windows 95 remains vulnerable to crashes.

WINDOWS NT WORKSTATION

Windows NT Workstation 3.51 is essentially a server operating system optimized for workstation use. This explains an architecture where absolute protection of applications and data take precedence over speed and compatibility considerations. Windows NT's extreme robustness comes at the price of high system overhead, so a fast CPU and at least 16MB of RAM are needed for acceptable performance. Like OS/2 Warp, Windows NT achieves low-memory security at the price of being incompatible with real-mode device drivers. Windows NT runs native 32-bit NT applications and most Windows 95 applications, too. Like Windows 95 and OS/2 Warp, Windows NT can also host 16-bit Windows and DOS applications.

The design of Windows NT's memory map is strikingly different from those of



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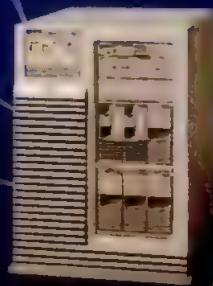
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Windows 95 and OS/2 Warp. Native applications see a private 2GB address space running from 64K to 2GB (the first 64K is fully nonaddressable). Applications are invisible to each other, though they can communicate via the Clipboard, DDE, and OLE.

At the top of each 2GB application space are what appear to the application as Ring 3 system DLLs. In fact, these are merely proxy stub forwarders called *client-side DLLs*. When the application calls most API functions, the client-side DLL issues a Local Process Communication (LPC), which passes the call and associated parameters to an entirely separate address space that contains the true system code. This *server process* performs parameter validation, executes the requested function, and passes the results back into the application's memory space. Although the server process itself is an application-level process, it is fully protected from and invisible to the application that called it.

From the 2GB to the 4GB mark are Windows NT's low-level Ring 0 system components including the kernel, thread scheduling, and the virtual memory manager. System pages in this region are marked with Supervisor privileges that are physically enforced by the processor's ring protection scheme. This keeps low-level system code from being visible to or writable by application-level code—and exacts a performance penalty when ring transitions occur.

Windows NT provides Windows on Windows (WOW) sessions for running 16-bit Windows applications. As with OS/2 Warp, Windows NT can run 16-bit Windows programs individually in private memory spaces or together in a shared address space. In almost all cases, 16-bit and 32-bit Windows applications can intercommunicate freely using OLE (via thunks when needed), regardless of whether they run in private or shared memory. Native applications and WOW sessions are preemptively multitasked on a per-thread basis. Multiple 16-bit Windows applications in a single WOW session are cooperatively multitasked. Windows NT can also multitask multiple DOS sessions. Because Windows NT is a fully 32-bit design, there are no theoretical limits to GDI and USER resources.

Your Next OS

Performance Results

Do the new 32-bit operating systems live up to their performance claims? Exhaustive performance testing gives a definitive answer.

By Ben Z. Gottesman, Jay Munro, Deval Shah, Danny Smith, and Todd Feinman

IF YOU'RE CONSIDERING AN UPGRADE TO A 32-bit operating system, you'll naturally be concerned about its performance with native 32-bit applications, and chances are, you'll care just as much about performance with the 16-bit applications you already use.

IBM has called OS/2 "a better DOS than DOS and a better Windows than Windows." Microsoft has claimed that performance under Windows 95 will be "at least" as good as what you get under current Windows (of course, if you aren't happy with your system's performance under Windows 3.1x, Microsoft isn't claiming that you'll suddenly be happy with Windows 95.) Even the high-end Windows NT Workstation 3.51 is positioned as "the most powerful desktop operating system."

TEST CATEGORIES

How well do these OSs really perform? PC Magazine Labs ran each of the oper-

ating systems through an exhaustive battery of thousands of test hours to establish how fast they really are.

Many of our tests concentrated on the performance of existing 16-bit Windows applications running as standalone tasks,

which is how many people will use the new OSs until native 32-bit applications are more prevalent. Wherever possible, we also tested the performance of native 32-bit OS/2 Warp, Windows 95, and Windows NT programs. Since DOS programs are still with us in

the form of legacy applications and games, we also tested their performance in the DOS environments provided by the operating systems.

Component-based applications and the increasing use of Object Linking and Embedding (OLE) raise new issues in performance. System performance is affected by the overhead of the container application on the OLE server as well as by interap-

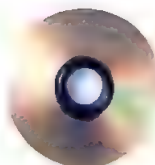




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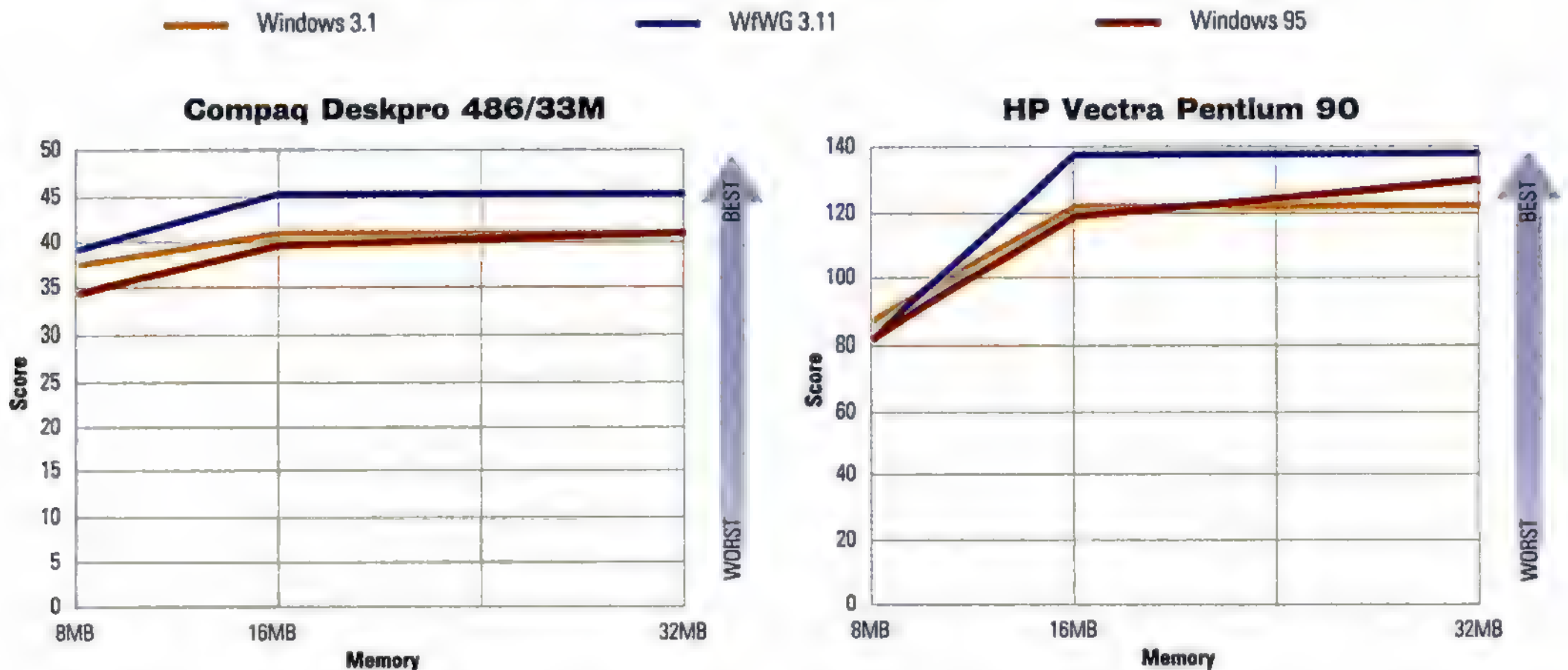
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WINSTONE 95

Does Windows 95 live up to its boast of performance parity with Windows 3.1? Actually, it comes pretty close. Our Winstone 95 benchmark tests showed Windows 95 to be just about on a par with Windows 3.1. The gap was widest on a 486 system with only 4MB of RAM. But on a faster Pentium system with 32MB of RAM, Windows 95 was actually faster. It was also the only operating system tested to show significant improvement with 32MB of RAM. Windows 95 was

slower than Windows for Workgroups 3.11 across the board, however. WfWG gets a lift from its write-behind caching, a feature that defaults to off in Windows 95.

The **Winstone 95** benchmark suite executes 13 of the most popular 16-bit Windows 3.1x applications and weighs the results according to real-world application profiles. Winstone 95 does not run on OS/2 Warp or Windows NT Workstation. Winstone 95 won't run with less than 8MB of memory.



application communication. We ran several tests that looked at various types of OLE operations. Finally, heavy multitasking has become a more viable option with the new operating systems, which all support preemptive multitasking, so our tests covered this area as well.

We ran all tests on both 486- and Pentium-based platforms—the Compaq Deskpro 486/33M and the Hewlett-Packard Vectra XU 5/90C—at multiple RAM configurations ranging from 4MB to 32MB.

WHAT WE FOUND

Microsoft appears to have come close to its performance claims with Windows 95. While the new operating system rarely tracked exactly with either Windows 3.1 or Windows for Workgroups, its performance was generally in the same range.

We were somewhat disappointed with the performance of IBM's OS/2 Warp as a platform for 16-bit Windows applications. OS/2 Warp ran them consistently slower, although not drastically slower, than either Windows 3.1x or Windows 95. Comparing the performance of native OS/2 applications with native Windows appli-

cations remains problematic since revision levels of the same product across OS/2 and Windows platforms vary considerably. We look forward to the shipment of applications such as Lotus's Word Pro, which will be available for 16-bit Windows, 32-bit Windows, and 32-bit OS/2, to gain further insight.

Windows NT Workstation generally lagged behind Windows 3.1x and Windows 95, although it was sometimes able to edge out OS/2 Warp. It delivered its best performances with 32MB of RAM.

Our test results also make it clear that we can't recommend upgrading to a 32-bit operating system on a 4MB computer. Whatever the cost of the upgrade, you'll find your money better spent by holding off until you can upgrade to 8MB. The performance difference from 4MB to 8MB megabytes is so substantial that it actually overshadows the operating system decision.

If you run only a single application, 8MB of RAM is probably sufficient for normal tasks under all these operating systems (except for Windows NT, which requires a minimum of 12MB to run). But even simple task switching under Win-

dows 95 will run much better under 16MB of memory. For all the operating systems, we saw evidence for the 16MB sweet spot in our OLE tests, which put two applications in memory simultaneously and add the overhead for interapplication communication.

Currently, the only operating system to show significant improvement moving from 16MB to 32MB of RAM is Microsoft's Windows NT Workstation, which also happens to be the operating system with the highest initial memory requirements. At 32MB, its performance was on a par with the other operating systems tested. But you should carefully consider your needs before moving to a 32MB system. Your money might be better spent on a lighter-weight OS and other performance-enhancing hardware, such as additional cache memory or a faster hard disk or graphics adapter.

WINSTONE 95 TEST

Since many people will continue to use 16-bit Windows applications under Windows 95, we also tested with our Winstone 95 benchmark suite, which executes 13 of the most popular 16-bit Windows 3.1x ap-



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plications to measure a system's performance. Winstone doesn't run on OS/2 Warp or Windows NT because of incompatibilities with its control program, Microsoft Test, and these operating systems. Because of the memory requirements of some of the component applications in Winstone, the benchmark test will not run on a 4MB system.

Windows for Workgroups was the first

version of Windows to introduce a 32-bit file-access driver to replace the slower real-mode disk access of Windows 3.1. It also added VCACHE, a 32-bit cache used in place of SmartDrive. VCACHE defaults to using write-behind caching, a potentially dangerous scheme that speeds system performance by delaying hard disk writes until the system is idle. Windows 95 also uses 32-bit file access and VCACHE

but doesn't default to write caching. The Windows 95 cache is also dynamic, growing and shrinking to meet the system's needs.

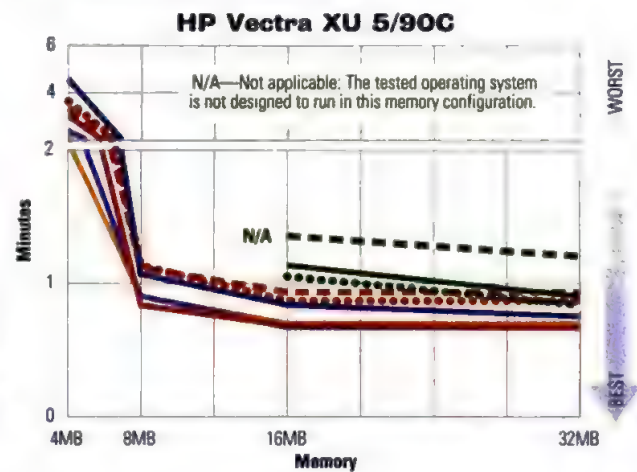
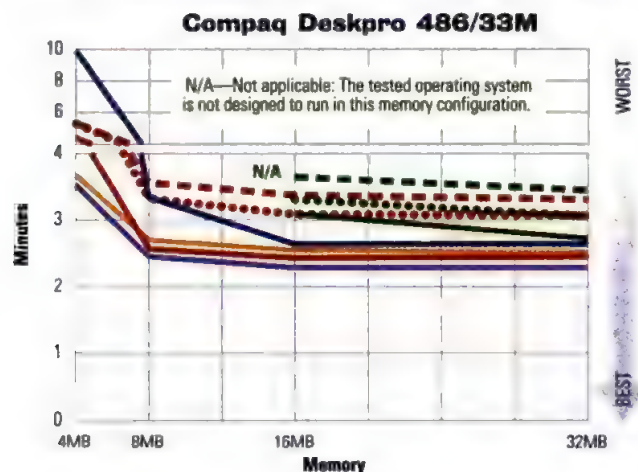
In general, Windows for Workgroups proved the fastest of the three Windows variants, although not by a substantial amount. This could be attributed, at least in part, to write-behind caching. Windows 3.1 and Windows for Workgroups perform-

PERFORMANCE: MICROSOFT WORD

The **Microsoft Word** test is based on a broad set of commonly executed word processing tasks. We tested all the operating systems using 16-bit Word 6.0a, the

32-bit Word for Windows NT, and a preview version of 32-bit Word 7.0 for Windows 95. We ran the test at four different memory points on 486 and Pentium systems.

- | | | |
|-----------------------------|--------------------------------|--|
| — Windows 3.1 (16-bit Word) | - - - Windows 95 (32-bit Word) | — Windows NT 3.51 (16-bit Word) |
| — WFWg 3.11 (16-bit Word) | ... Windows 95 (32-bit Word) | - - - Windows NT 3.51 (32-bit Word NT) |
| — Windows 95 (16-bit Word) | — OS/2 Warp 3.0 (16-bit Word) | ... Windows NT 3.51 (32-bit Word 95) |

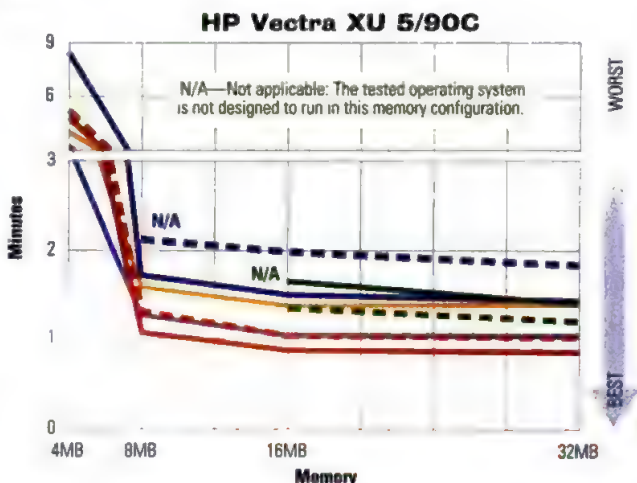
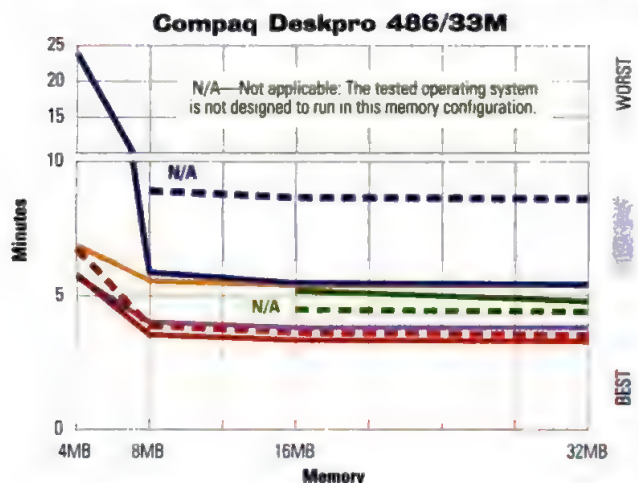


PERFORMANCE: MICROSOFT EXCEL

The **Microsoft Excel** test covers typical spreadsheet functions, including calculations, charting, edit functions, and printing. We used 16-bit Excel 5.0 and the 32-bit

Excel for Windows NT. We also used Athena Software's Mesa for OS/2, a 32-bit OS/2 spreadsheet, which was able to emulate most of the Excel test macro.

- | | | |
|------------------------------|------------------------------------|---|
| — Windows 3.1 (16-bit Excel) | - - - Windows 95 (32-bit Excel NT) | — Windows NT 3.51 (16-bit Excel) |
| — WFWG 3.11 (16-bit Excel) | — OS/2 Warp 3.0 (16-bit Excel) | - - - Windows NT 3.51 (32-bit Excel NT) |
| — Windows 95 (16-bit Excel) | - - - OS/2 Warp 3.0 (32-bit Mesa) | |





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mance seemed to top out at 16MB, while Windows 95's performance continued to improve, probably as a result of the dynamic cache.

MICROSOFT WORD TEST

The Microsoft Word test is based upon the Word components of Winstone 95 and reflects the most common tasks executed in Word, including search and re-

place; spell-checking; a variety of formatting operations like character, paragraph, and document; and file operations like open, import of a text file, and import of two different WordPerfect documents.

Each operating system was tested with the 16-bit Windows version of Word 6.0. We also looked at 32-bit Word for Windows NT under Windows 95 and Windows NT. Since prior *PC Magazine* testing has

shown this program's performance to be subpar, we also tested the preview version of Word 7.0 for Windows 95.

Although all of the programs showed improvement going from 4MB to 8MB of RAM, the difference was most pronounced with OS/2 Warp. The working set of the test was such that 16MB proved ample for all the operating systems except Microsoft Windows NT 3.51, which

PERFORMANCE: MICROSOFT ACCESS

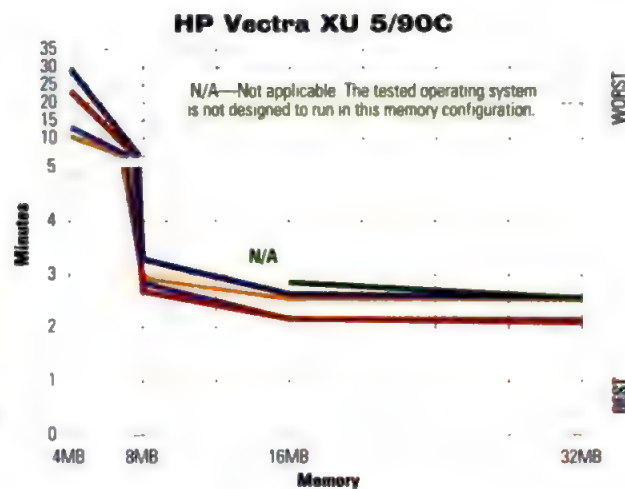
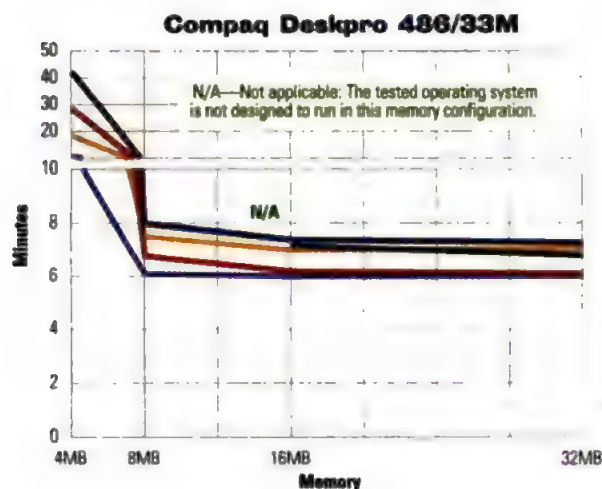
Based on the 16-bit Microsoft Access 2.0, this test uses a series of common database operations, including imports of files into tables, searches, updates, deletes,

and reporting. Performance on both hardware platforms tended to level off at 8MB, but the Pentium allowed the OSs to take better advantage of additional memory.

Windows 3.1
WWG 3.11

Windows 95
OS/2 Warp 3.0

Windows NT 3.51



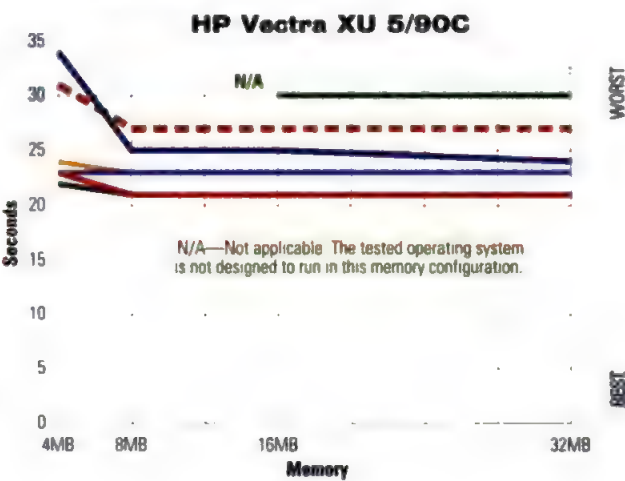
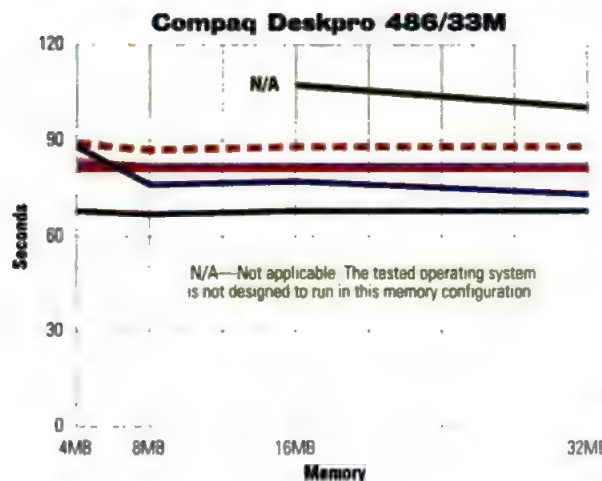
PERFORMANCE: WORDPERFECT 5.1 FOR DOS

WordPerfect 5.1 for DOS, the basis of this test, is the most popular DOS word processor ever. OS/2 Warp and Windows 95 showed some improvement going

from 4MB to 8MB of RAM. Otherwise, memory was not a factor. With their idle sensitivity set to low, the GUI environments fared only slightly worse than DOS.

MS DOS 6.2
Windows 3.1
WWG 3.11
Windows 95 (character mode)

Windows 95 (GUI mode)
OS/2 Warp 3.0
Windows NT 3.51



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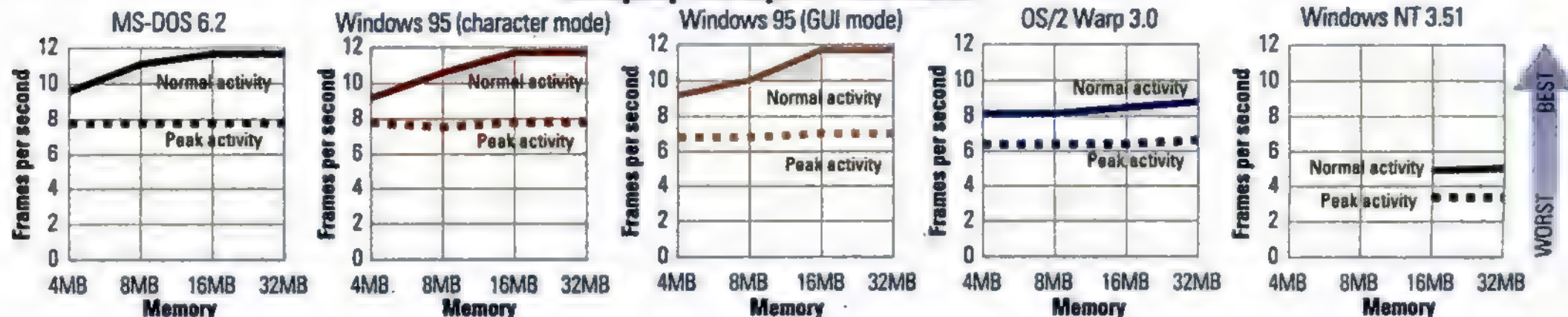
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FRAMES PER SECOND: DOOM II

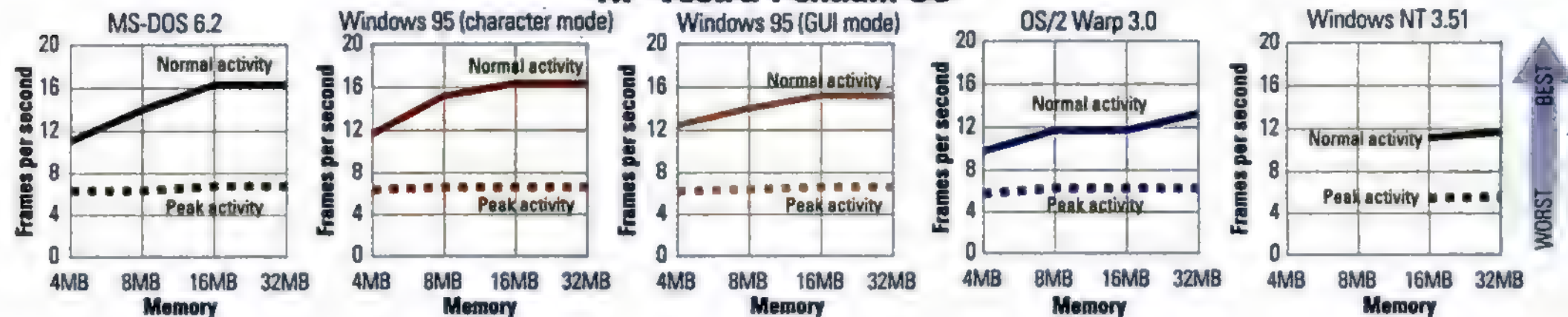
The **Frames per Second** test measures animation frame rates in DOOM II under normal game activity and peak game activity. Although all operating systems dropped

frames at peak levels, the normal and peak ranges varied widely. DOOM II did not run under Windows 3.x, and we did not test Windows NT with less than 16MB of RAM.

Compaq Deskpro 486/33M



HP Vectra Pentium 90



showed slight improvement with 32MB.

For raw speed, the 16-bit versions of Word proved faster than the 32-bit versions, though the more finely tuned 32-bit optimizations found in Word for Windows 95 helped somewhat. Until more 32-bit applications arrive, it will be difficult to draw conclusions as to which platform is fastest.

We had hoped to build a similar test in Ami Pro to test a native 32-bit OS/2 app against its 16-bit Windows counterparts and Word. But certain commands couldn't be executed in the OS/2 version's macro language, invalidating the comparison.

MICROSOFT EXCEL TESTS

Like the Word test, the Microsoft Excel test is based upon the Winstone 95 benchmark tests. It tests typical spreadsheet functions including calculations, charting, edit functions, and printing. For comparison, we also tested Athena Software's Mesa for OS/2, a native 32-bit OS/2 spreadsheet that was able to emulate the Excel test macro with the exception of print and print-preview operations. We also included the 32-bit Microsoft Excel 5.0 for Windows NT.

Because Excel requires a fair amount of memory to run, we saw a large improvement in performance going from 4MB to 8MB of RAM. And because the

model used by the test was not so large as to demand substantial memory, performance tended to flatten out at higher memory points.

The purpose of testing Mesa was less to compare its overall times with Excel than to see what sort of effect additional memory had on a native OS/2 app. Mesa was capable of handling the test scenario of 8MB, and we saw only minimal performance improvements at the larger memory points.

Much of the difference in overall speed can be attributed to print speed. The Windows 3.1 configuration used an older LaserJet III print driver. Improvements in the driver between the release of Windows 3.1 and Windows for Workgroups 3.11 cut the spooling time nearly in half. Further improvements to the printing subsystem in Windows 95 account for its even faster scores.

MICROSOFT ACCESS TEST

The Access test is based on standard database operations including imports of files into tables, various searches, updates, deletes, and reporting. Although Microsoft recommends a minimum of 6MB of RAM for Access, we ran the tests at 4MB (and learned why Microsoft recommends 6MB).

Performance generally leveled off at

8MB, but Windows NT showed some improvement moving from 16MB to 32MB, apparently because of Windows NT's own considerable overhead, even in 16MB.

WORDPERFECT FOR DOS TEST

The WordPerfect 5.1 for DOS test is patterned after the Microsoft Word tests, but we minimized or eliminated tasks that were unlikely to be executed in a DOS character-mode word processor.

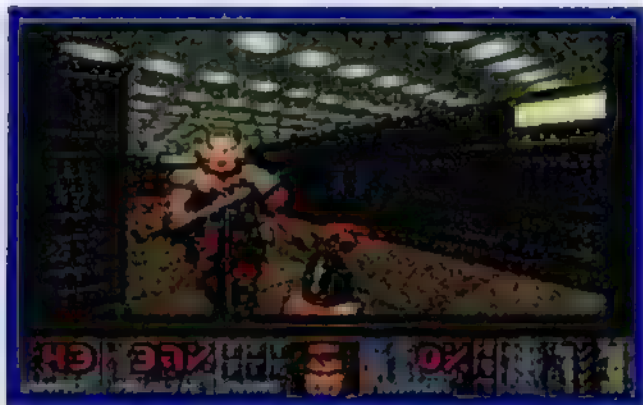
Initial runs of WordPerfect under the various flavors of Windows and OS/2 were extremely slow compared with MS-DOS; in some cases, the difference was by an order of magnitude. The culprits appeared to be the search-and-replace operation and printing.

Analysis showed that it was necessary to optimize the DOS sessions by setting Idle Sensitivity in the Program Information File (.PIF) to Low. The Idle Sensitivity setting controls how long the operating system will allow the program to remain idle before allotting portions of its resources to other tasks. Moving the setting to Low causes the application to poll the CPU and keyboard for cycles less frequently.

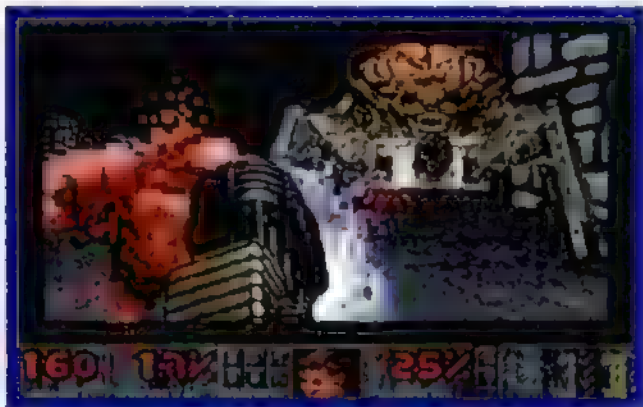
GAME PERFORMANCE: DOOM II

Both Windows 95 and OS/2 Warp claim to be able to run most DOS games. Win-

Operating Systems



NORMAL ACTIVITY: Running down a hallway with a moderate quantity of objects.



HIGH ACTIVITY: A full-blown gore zone with dozens of enemies.

6.2 as a baseline comparison. DOOM II doesn't run under Windows 3.1x.

We looked at three measurements of the game's performance: load time, frame rate during normal activity (running down a normal hallway with a medium quantity of objects on the floor), and frame rate during stress activity (moving about a full-blown gore zone with dozens of enemies). Load time measured the time to load the DOOM operating system and a custom demo. We tested without sound, since sound does not work under Windows NT.

Because DOOM II doesn't take advantage of memory over 8MB during load time, DOS and Windows 95 character mode—which don't create much overhead—saw little benefit of extra memory. Under the graphical environments, much memory is consumed by the operating system itself; the game can use only remaining memory (or virtual memory), and therefore benefits from larger amounts of RAM.

During normal and stress play, Windows 95, with or without its graphical environment, was able to keep up with DOS. OS/2 Warp was consistently slower, with a frame rate up to one-third lower. The frame rate reported for Windows NT at 16MB on the Compaq, 3.33 frames per second, is the lowest number that DOOM can report. Visually, it was obvious that the frame rate was actually lower.

The architecture of Windows NT is poorly adapted for games such as DOOM, which tend to write directly to the hardware. To maintain stability and reliability, Windows NT doesn't allow such operations and instead emulates them through software, which severely impacts speed.

OLE PERFORMANCE TESTS

Our OLE tests consist of 11 tasks within Microsoft Word 6.0, Microsoft Excel 5.0, and Borland's Paradox for Windows 5.0.

The tested tasks included the following: Launch WordArt and modify an existing WordArt object inside a Word document; exit WordArt and return control to Word; drag-and-drop an Excel chart into a Word document; create an Excel worksheet within a Word document; apply AutoFormat to the Excel worksheet; in-place edit the Excel worksheet; edit the existing chart using a separately launched instance of Excel; invoke in-place editing on an embedded Paradox table; update a Paradox table; edit an Excel chart within the Word document that is linked to an Excel Workbook on disk; and update a linked chart.

All tests were run on 16-bit versions of the applications. The Warp tests were conducted within a full-screen Win-OS/2 session. Under Windows NT, the applications ran within a shared Windows on Windows

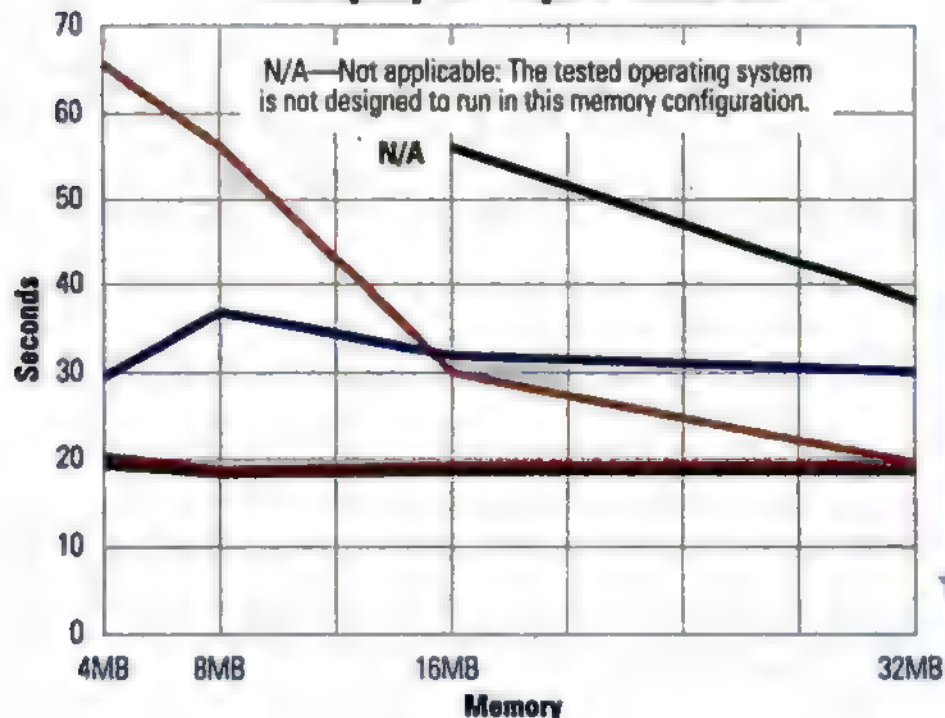
PROGRAM LOAD TIME: DOOM II

The **Program Load Time** test for DOOM II measures the time it takes to load the DOOM operating system and a custom demo. While the curves for the character-

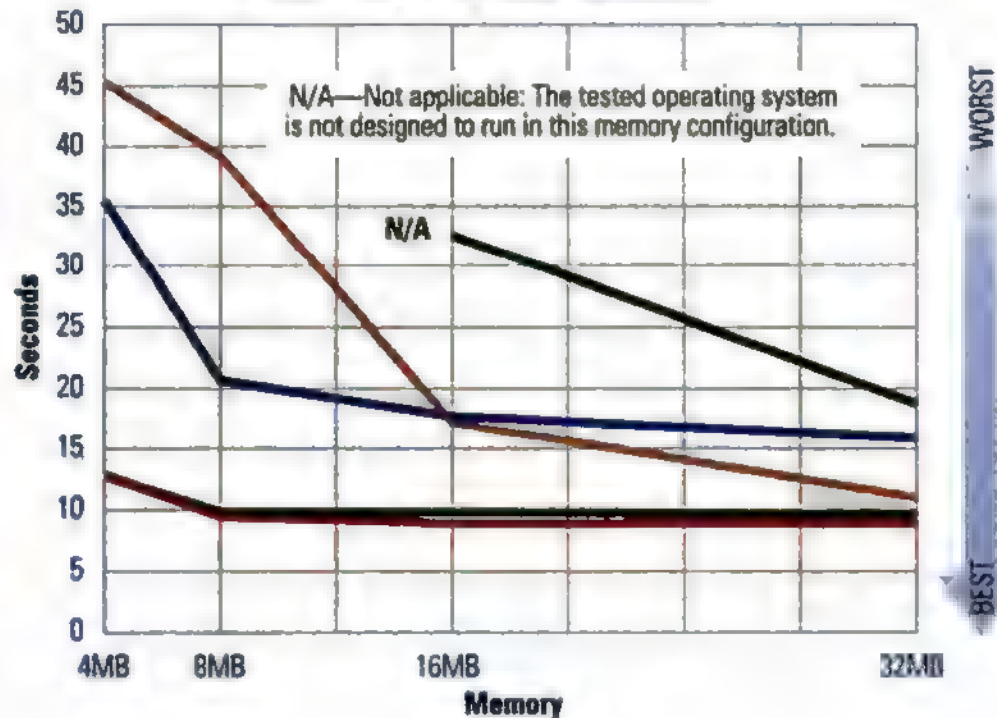
mode OSs flattened out at 8MB because of their low overhead, the GUIs benefited from additional memory.

— MS-DOS 6.2 — Windows 95 (character mode) — Windows 95 (GUI mode) — OS/2 Warp 3.0 — Windows NT 3.51

Compaq Deskpro 486/33M



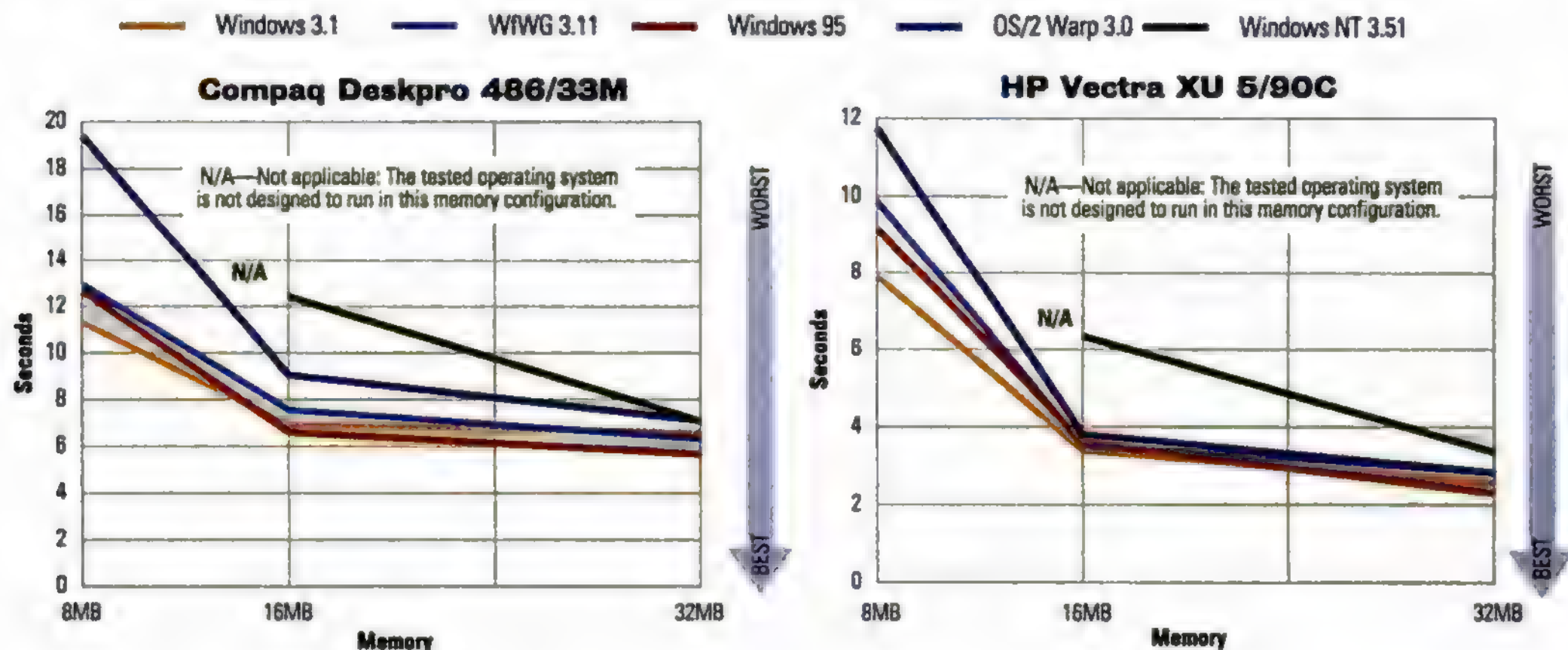
HP Vectra XU 5/90C



PERFORMANCE: OLE

Our **OLE** tests consist of 11 OLE operations involving Microsoft Word 6.0, Microsoft Excel 5.0, and Borland's Paradox for Windows 5.0. Scores shown

represent the means of the individual task scores. Only OS/2 Warp and (especially) Windows NT benefited from RAM beyond 16MB.



(WOW) session. We did not test at 4MB.

Timings for the individual test components ranged from less than 1 second to nearly 40 seconds. We report the arithmetic mean of the individual task scores. Because OLE requires two applications (or portions thereof) to be running in memory simultaneously, system performance tended not to level off until 16MB, while most of our single application tests leveled off at 8MB. Due to Windows NT's overhead, its OLE results did not come in line with the other operating systems until we upgraded to 32MB of RAM.

MULTITASKING TESTS

To test multitasking, we selected tasks that represent the kind of multitasking an average user would do. With the Internet, e-mail, and on-line services skyrocketing, a communications download running at the same time as an intensive disk I/O operation was an obvious choice.

As the communications component, we used Hilgraeve's HyperAccess program in several flavors. For testing 16-bit communications under Windows 3.1, Windows for Workgroups 3.11, Windows 95, and Windows NT, we used HyperAccess 2.01. For 32-bit testing on Windows 95 and OS/2, we used the bundled HyperTerminal and HyperAccess Lite for OS/2, respectively. HyperAccess is a high-per-

formance communications package, which on Windows 95 and OS/2 Warp takes advantage of multithreading, and on Windows 3.1 simulates multitasking by separating the communications port module from the display module.

We were not able to test both 16-bit and 32-bit communications programs on all platforms. We were unable to get HyperAccess for Windows to run reliably on OS/2 Warp; on Windows NT, HyperAccess is not available yet in a 32-bit version. According to Hilgraeve, HyperTerminal for Windows 95 does not work under Windows NT either, because it uses TAPI (Telephony API), which is not yet supported.

We made the communications transfer using a 4MB .ZIP file to prevent modem compression from affecting the test, and we used the ZModem protocol running at 28.8 Kbps. We used two Practical Peripherals 28.8-Kbps V.34 modems, connected with a Skutch phone-line emulator to provide a consistent phone line.

To provide the disk I/O component of the test, we performed an XCOPY of 96MB of binary and text files from one directory to another. The versions of XCOPY were all 16-bit except for Windows NT's, which is a 32-bit utility.

The multitasking test consisted of three parts: a standalone timing of the XCOPY to establish a baseline, the tim-

ing of the XCOPY with a concurrent download (multitasking), and a standalone download running for the same duration as the multitasked XCOPY. The tests were performed on a Pentium HP Vectra XU 5/90c and a Compaq Deskpro 486/33M in 16MB configurations. The XCOPY was run in the foreground with a self-timing batch file, and the download was set up in the background and initiated from the remote-source machine.

Each operating system was set up with its default tasking. We tested Windows NT and OS/2 Warp using FAT volumes and also using their native file systems NTFS and HPFS, respectively.

When evaluating multitasking, there are two important measurements to consider: How would each task perform were there no other tasks running, and how much performance was degraded in *each* task when both were multitasked. The charts show the performance of each task during multitasking (the foreground bars) and the standalone performance of the same task (the background bars). The bars are grouped in pairs by operating system. The left bar in the pair represents the XCOPY throughput; the right bar, the download throughput. The gap between the foreground bars and the background bars shows the degradation during multitasked operations. The smaller the gap, the

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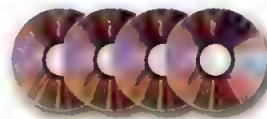


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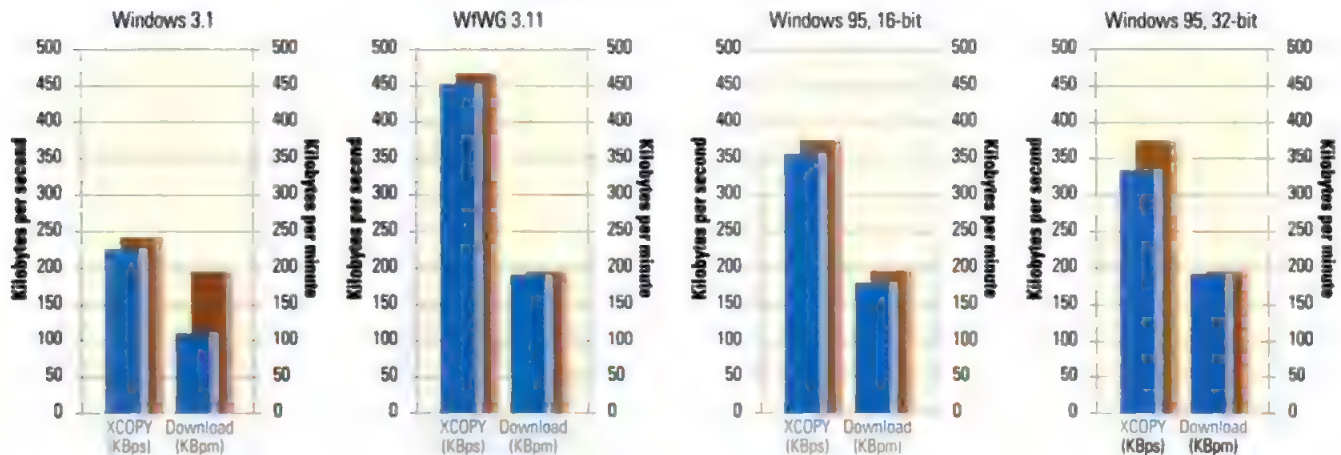
MULTITASKING

Our **Multitasking** test measures throughput for two tasks: intensive disk I/O activity generated by a huge XCOPY operation and a file download through a communications program. The charts show the throughput achieved by both tasks

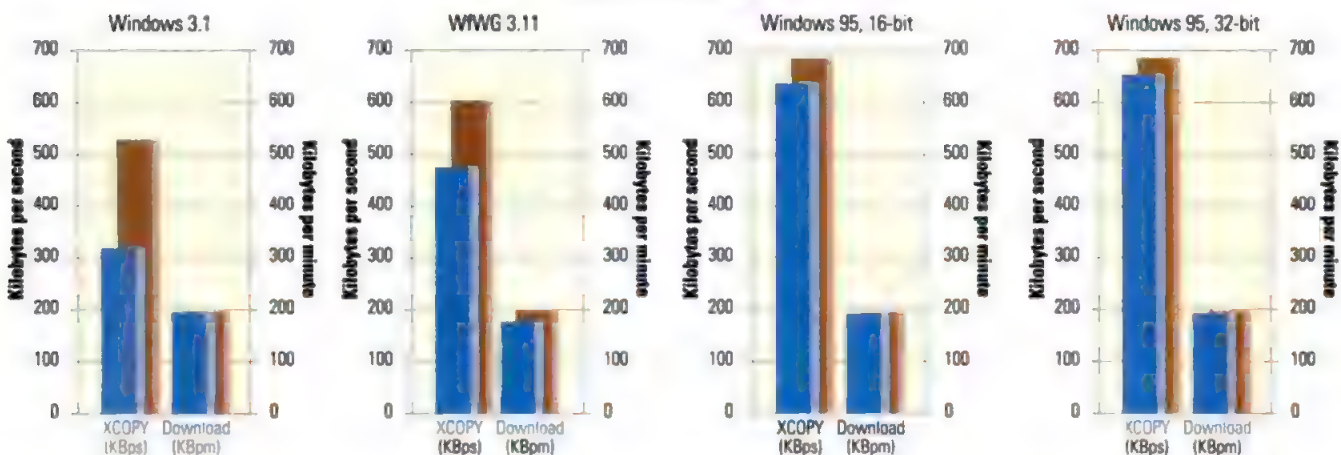
running simultaneously (shown by the bars in the foreground) and the throughput achieved by each task running independently (shown by the bars in the background). The difference in height between the foreground and background bars

 Multitasking  Standalone

COMPAQ DESKPRO 486/33M



HP VECTRA XU 5/90C



less degradation for the task. The XCOPY results are presented in kilobytes per second, while the multitasking results are shown in kilobytes per minute (so that the bars are on a specially comparable scale).

Across all operating systems and on both machines, standalone downloads achieved about the same throughput, around 200 Kbpms. But the amount of degradation introduced in each OS by multitasking varied widely by hardware platform.

On the Pentium system, the throughput of the download for all operating systems degraded around 1 percent when multitasking. Windows for Workgroups was the exception, for which the throughput

dipped about 10 percent.

The 486/33 system was a different story, however, with Windows 3.1, OS/2 Warp, and Windows NT showing degradations of up to 48 percent, while Windows 95 and Windows for Workgroups showed only about 8 percent degradation on multitasking.

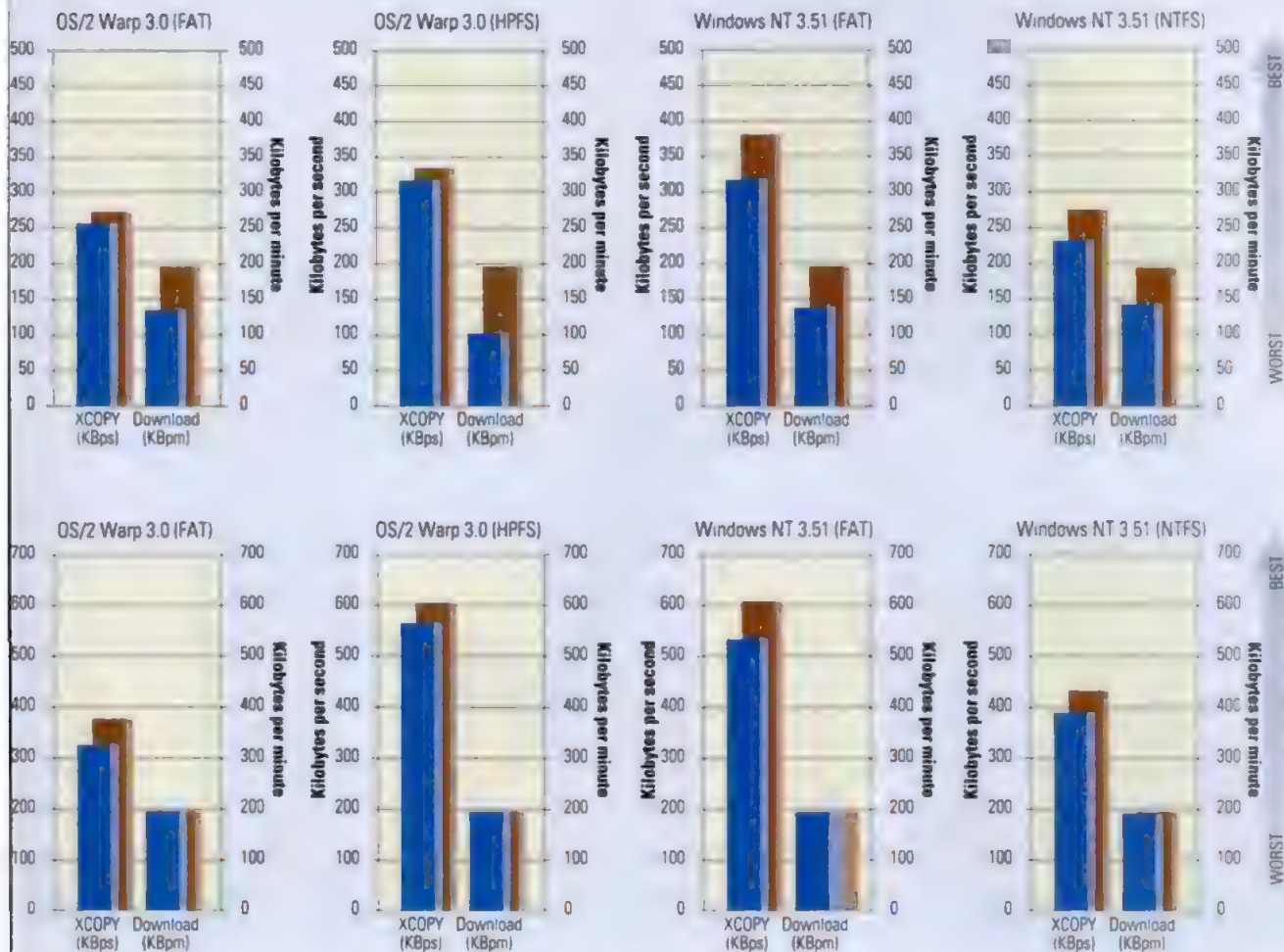
The XCOPY portion also showed some interesting differences between systems. On the 486/33, all operating systems showed deltas of less than 10 percent between standalone and multitasked copies except Windows NT on FAT, which showed about a 17 percent degradation when multitasked. On the Pentium, the 32-bit operating systems showed far less

degradation when multitasked than the 16-bit ones, with Windows 3.1 showing a 40 percent degradation and WWG showing a 22 percent degradation.

Another interesting difference showed up between OS/2 and Windows NT. Both support FAT and a native high-performance system. On OS/2, HPFS provides faster throughput on the XCOPY, while on Windows NT, FAT is the speed winner over NTFS, due to NTFS's higher security overhead. The raw speed winner on the Pentium is Windows 95, while Windows for Workgroups is superior on the 486 test-bed. (The Quantum drive in our HP Vectra test platform does not support Windows' 32-bit disk access.)

shows the degradation due to multitasking. Where possible, we tested using both 16-bit and 32-bit versions of Hilgraeve's communications program HyperAccess (The 16-bit Windows version did not run successfully under OS/2, and a 32-bit

Windows NT version was not available.) We tested OS/2 Warp and Windows NT using FAT volumes and their native high-performance file systems



In short, if you are going to do multitasking, you will usually get the best relative performance on a Pentium. Our results showed that on the communications download, which requires attention from an application to keep the buffer from overflowing or to control the incoming stream, the Pentium supplied enough horsepower that all systems were able to work at full capacity on either the stand-alone or multitasking test. The Compaq appeared to throttle back on the download during the multitasking on most OSs. In conclusion, using a Pentium, Windows 95 gives the best overall performance of all operating systems, with OS/2 and Windows NT coming in second.

OUR TEST PLATFORMS

We tested on both mainstream and high-end systems. The mainstream systems were Compaq Deskpro 486/33M units with 340MB hard disks and Compaq QVision 1024 graphics adapters. The high end was represented by HP Vectra XU 5/90C with 540MB hard disks and Matrox MGA PCI/2 graphics adapters units.

The systems were configured for 4MB, 8MB, 16MB, and 32MB of memory. Except where otherwise noted, our Windows NT system used the NTFS, and OS/2 Warp used the HPFS. Tests of OS/2 Warp at 4MB memory points were performed with OS/2 Warp 3.0 Full Pack (not OS/2 Warp Connect) using the FAT file system.

Each system was configured with the settings according to the vendor's recommendations. For Windows 3.1, we set the SmartDrive cache to one quarter of the system memory; the exception was for 32MB, where we used a cache size of 4,096K. We used the same settings for DOS testing on Windows for Workgroups and VCACHE for caching within Windows. Windows NT 3.51 and Windows 95 installed at the optimum settings for the hardware found in the system, so those OSs were left at the default values. IBM recommended that we set the OS/2 Warp Full Pack and OS/2 Warp Connect cache to 48K at 4MB, 512K at 8MB, and 10 percent of physical memory at the higher memory points.

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Windows 95



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Your Next OS Stability & Capacity

Our stress tests provide hard data on the comparative robustness and capacity of the four competing operating systems.

By Matt Pietrek

THROUGHOUT ITS LONG PRERELEASE period, the Windows 95 architecture underwent intense scrutiny. Is it really more stable than Windows 3.1? How robust is it relative to Windows NT Workstation 3.51 or IBM's OS/2 Warp 3.0? How well does it handle unruly 16-bit and 32-bit applications? We have written a small suite of applications to put Windows 95 and its major competitors to the stress test.

The results (see the sidebars "Bomb Damage" and "Capacity at a Glance") show Windows 95 to be a somewhat better-protected operating system than its 16-bit predecessors. But OS/2 Warp offers a significantly more secure protection model than Windows 95, while Windows NT was totally invulnerable to every attempt to crash it. On the capacity front, measured by available system resources, Windows 95 has improved dramatically on 16-bit Windows versions.

The test suite consists of seven apps. The 16-bit BOMB16 and 32-bit BOMB32 programs attempt to crash the oper-

ating systems by overwriting critical memory areas. The THRDTEST application, which runs only under Windows 95, monitors the effect of threads on free system resources. W16MTX16 and W16MTX32 examine the effect of applications slow to yield CPU control. WNDTST16 and WNDTST32 test how many on-screen windows can exist in the system at once.



The 16-bit applications run under all five tested operating systems (OS/2 supports Win16 programs via an isolated Win-OS/2 session). All 32-bit tests (except the Windows 95-specific THRDTEST) run under everything but Windows 3.1 and Windows for Workgroups 3.11.

The source code and executable files for these programs can be downloaded from the PC Magazine Labs Web page (<http://www.zdnet.com/~pcmag/pclabs/pclabs.htm>) or from the PC Labs library of ZD Net's Utilities/Tips forum (GO ZNT:TIPS on CompuServe). For an in-

depth discussion of the test apps' inner workings, see "OS Crash Tests" in this issue's PC Tech section.

THE 16-BIT BOMBS

BOMB16 is divided into three separate tests. The first test creates a common general protection (GP) fault by trying to write to a read-only segment in memory. Each operating system correctly caught the exception, notified the user of the error via a dialog box, and terminated the errant application. The test proves that an ordinary programming error in a 16-bit application does not necessarily crash the less-stable operating systems.

The second BOMB16 test overwrites the first 64K of DOS conventional memory. When the test was executed, Windows 3.1x instantly crashed and exited to a DOS prompt, while Windows 95 froze and required a cold reboot. Both of these OSs make calls to the DOS core that they rest on and are susceptible to such overwrites. Windows NT and OS/2, on the other hand, handled this intrusion with aplomb. OS/2 shut down its 16-bit Win-OS/2 session, while Windows NT simply terminated the offending application.

The final BOMB16 test locates a key system DLL and overwrites its data area with zeros. The results of this test were similar to those of the low DOS memory overwrite; both Windows 3.1x and Windows 95 were stopped cold and required a reboot, whereas Windows NT and OS/2 gracefully terminated the 16-bit session that BOMB16 was running in.

These tests demonstrate why operating system gurus laud separate, protected address spaces. In Windows 3.1x and Windows 95, certain vital data areas are made accessible to all apps to streamline code execution. Badly behaved programs, however, can bring these systems down. In contrast, operating systems such as Windows NT and OS/2 emphasize broader protection of address spaces to keep unruly applications away from vital data areas. Errant applications in these systems can self-destruct or terminate programs that are running in the same session, but they cannot harm the core of the operating system. Operating system designers make a trade-off between performance and backward compatibility on the

one hand and robustness on the other. When you pick an OS, you have to make the same choice.

THE 32-BIT BOMBS

Like BOMB16, BOMB32 is divided into several different tests. The first creates a common page fault exception that is similar to those triggered by buggy 32-bit programs. As with the GP fault test in BOMB16, each 32-bit operating system—Windows 95, Windows NT, and OS/2—displayed an error message, then terminated the program. This is the normal, expected behavior.

The second and third tests in BOMB32 attempt to write to the first 1MB of memory. Two tests are required because this area is broken up into two halves under Windows 95. The lower section, which is used by DOS and device drivers that are loaded via CONFIG.SYS and AUTOEXEC.BAT, starts at address 0. The system does not allow Win32 applications to overwrite this area of memory. When BOMB32 attempted such an overwrite, Windows 95 caught the fault and terminated the program.

The upper portion of the first megabyte, which contains key data areas and Windows 95 system code, starts immediately above the protected lower region. To avoid serious performance problems, however, the region is not protected from unruly 32-bit applications; BOMB32

overwrote the region and the system crashed.

Windows NT and OS/2 do not store critical system data in the conventional memory below 1MB, and they protect these addresses. Thus, they were unaffected by BOMB32's overwrites; both Windows NT and OS/2 terminated the test and continued normal operations.

Like its BOMB16 counterpart, the final portion of BOMB32 locates the data area of a key system DLL and overwrites it. Because this data area is shared by all 32-bit applications under Windows 95, the BOMB32 overwrite brought the operating system to its knees. In Windows NT, however, each application has its own

copy of the data-area proxy stubs. When BOMB32 attempted its overwrite, other applications in the system were not affected. OS/2 Warp does not protect data pages of some important system DLLs; the OS/2 port of this test was able to scribble on PMWIN.DLL, causing a full crash.

THE WINDOWS 95 THREAD TEST

Late in the Windows 95 beta cycle, it became apparent that applications that created numerous threads tended to drain free system resources. Microsoft claims to have resolved the problem with the final version of the code; our THRDTEST application shows that this is not an unreasonable claim.

THRDTEST is a Windows 95-specific program that creates system threads and monitors their effect on the USER and GDI resources. System threads are divided into two major categories: those with message queues and those without message queues. Threads with queues can exchange information with other applications, while threads without queues stand alone. THRDTEST allows the user to create both types of threads while monitoring the free system resources.

Using THRDTEST to create numerous threads without message queues had no effect on the available resources in Windows 95. In contrast, the free system resources dropped 1 percent for every eight threads with queues. The drain occurs because message queues require a 96-byte block in USER's 64K heap. Since the first 10K of the 64K segment is used for global variables, the heap is roughly 54,000 bytes in size and can hold 560 threads with queues. With other items competing for space in the USER heap, however, the practical maximum is closer to 450. Theoretically, Windows NT and OS/2 can support an unlimited number of threads, but users reaching even 450 threads are few and far between; the system becomes much too slow for normal operation.

THE WIN16MUTEX PROBLEM

In many operating systems, an application that has the focus and is slow to yield control of the CPU can create problems. W16MTX16 and W16MTX32 test the effects of such an application on the surrounding system. Each test launches two

Theoretically, Windows NT and OS/2 can support an unlimited number of threads. But users reaching even 450 are few and far between.

Bomb Damage

How well do Windows 3.1x, Windows 95, OS/2 Warp, and Windows NT protect against memory overwrites?

	Windows 3.1	Windows for Workgroups 3.11	Windows 95	OS/2 Warp 3.0	Windows NT 3.51
16-bit bombs					
Common GP fault	Recovers gracefully	Recovers gracefully	Recovers gracefully	Recovers gracefully	Recovers gracefully
Overwrites conventional memory below start of Windows	Crashes	Crashes	Crashes	Terminates 16-bit session and recovers gracefully	Recovers gracefully
Overwrites system DLL	Crashes	Crashes	Crashes	Terminates 16-bit session and recovers gracefully	Terminates 16-bit session and recovers gracefully
32-bit bombs					
Common page fault	N/A	N/A	Recovers gracefully	Recovers gracefully	Recovers gracefully
Overwrites conventional memory below start of Windows	N/A	N/A	Recovers gracefully	Recovers gracefully	Recovers gracefully
Overwrites conventional memory above start of Windows	N/A	N/A	Crashes	Recovers gracefully	Recovers gracefully
Overwrites system DLL	N/A	N/A	Crashes	Crashes*	Recovers gracefully

N/A—Not applicable: 16-bit Windows versions do not natively support 32-bit applications. *The OS/2 version of this test attempts to overwrite the system DLL PMWIN.DLL.

Capacity at a Glance

How do multiple windows and threads with message queues affect resource consumption in Windows 3.1x, Windows 95, OS/2 Warp, and Windows NT?

	Windows 3.1	Windows for Workgroups 3.11	Windows 95	OS/2 Warp 3.0	Windows NT 3.51
Maximum number of threads with message queues	N/A*	N/A*	About 450	Unlimited	Unlimited
Free USER resources with a maximum number of threads	N/A*	N/A*	0%	N/A**	N/A**
Number of window objects created (maximum 1,600)	848	843	16-bit: 1,600; 32-bit: 1,600	Win-OS/2: 837; native OS/2: 1,600	16-bit: 1,600; 32-bit: 1,600
Free system resources after creation of windows	0%	0%	16-bit: 92%; 32-bit: N/A**	Win-OS/2: 0%; native OS/2: N/A**	16-bit: 90%; 32-bit: N/A**

N/A*—Not applicable: Windows 3.1x and Windows for Workgroups do not support threads.

N/A**—Not applicable: We did not measure free system resources under 32-bit operating systems. There are no limitations on system resources in OS/2 or Windows NT.

instances of a clock application that displays the current time in a window. The time display is updated every second. From a menu selection, the user can start a block loop in one window that runs for 10 seconds while observing the behavior of the other window.

Under Windows 3.1x, the second window halts completely when the first window is blocked. In fact, W16MTX16 halted all the other programs in the system as well; they would not respond to mouse and keyboard input until the loop had finished. Windows 3.1x is a cooperative multitasking system that expects applications to work quickly, then yield control to other tasks. A piggish application, therefore, can monopolize the entire system.

Due to the continuing presence of the Win16Mutex, the results of W16MTX16 were the same under Windows 95. Because 16-bit system code can be accessed by only one application at a time, Win16 applications are not allowed to preempt each other. Of course, this poses a problem for Windows 95, which must run 16-bit applications in its preemptive, multithreading environment. The answer is the Win16Mutex. To execute under Windows 95, a 16-bit task must claim the mutex, and new tasks cannot be started until the mutex is released. Any 32-bit threads that stay out of the 16-bit system code will continue to run, but mouse, keyboard, and screen-drawing control are lost.

W16MTX16 caused similar failures under Windows NT and OS/2. Because both clock windows were created in the same 16-bit session, the second window could not receive CPU time while the first window had the focus and was blocked. (If the two windows are in separate Win16 sessions under OS/2 Warp or Windows

NT, however, the second clock can continue to execute.)

The W16MTX32 test produced vastly different results. Under Windows 95 and Windows NT, the second clock continued to function normally as the first clock went into its loop. In Windows 95, wholly 32-bit applications do not have to own the Win16Mutex to execute, and Windows NT does not require a Win16Mutex.

Windows 95 offers
clear if sometimes
modest improvements
in stability and capacity
over earlier versions
of Windows.

When run under OS/2, the results of W16MTX32 are not as impressive; after the first clock window is blocked, the time on the second window does not stop, but it does slow down. At its core, OS/2 Warp has an input system that resembles Windows 3.1x; a native OS/2 application that does not yield CPU control will prevent other programs from executing user-interface code. OS/2 Warp, however, attempts to detect when applications are not yielding control. If necessary, the system steals the focus from a nonyielding application and tries to give control to the next application in the window Z-order. This method, however, is not perfect; only the application that is second in line will ever get the chance to run, and other applications will remain blocked until the program with the focus yields control.

WINDOWS AND MORE WINDOWS

The WNDTST16 and WNDTST32 applications test the number of windows that can be created at one time. The tests attempt to produce up to 1,600 button window objects, but will halt execution if the system is saturated before the limit is reached.

Under Windows 3.1x, WNDTST16 created roughly 850 windows. Such a figure may seem large, but every button, dialog box, icon, and edit control in a GUI operating system is probably a separate window object. During the creation of these 850 windows, the USER free system resources dropped from 83 percent to 0; every window created under Windows 3.1x requires roughly 60 bytes of USER's 64KB heap.

Since a copy of Windows 3.1 is run inside a Win-OS/2 session, WNDTST16 produces similar results under OS/2; the test created somewhat more than 800 windows, and the USER free system resources dropped from 85 percent to 0.

In contrast, WNDTST16 created the full 1,600 windows in both Windows NT and Windows 95 without any effect on the free system resources. In Windows 95, the maximum theoretical number of concurrent windows is just shy of 16,384, while in Windows NT, the number is limited only by available memory. Lastly, the 32-bit WNDTST32 reached 1,600 windows under Windows 95, Windows NT, and OS/2.

In conclusion, Windows 95 offers clear if sometimes modest improvements over Windows 3.1x in terms of stability and capacity. Greater benefits accrue from the use of OS/2 Warp, although it, too, has a few design loopholes that affect robustness. Of the four tested OSs, only Windows NT stands out as essentially bullet-proof and unconstrained.



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Your Next OS Compatibility Compared

Will moving to a 32-bit OS trigger an avalanche of compatibility problems? Find out what's likely to happen to you.

By Laura Cox and Ben Z. Gottesman

ANYONE CONSIDERING AN UPGRADE TO A 32-bit operating system will care a lot about its compatibility with existing hardware and software. To help you judge the degree of compatibility you're likely to encounter during an upgrade and to give you some sense of the installation problems you may run into, we selected ten typical system configurations and performed upgrades from Windows 3.1x to Windows 95, OS/2 Warp 3.0, and Windows NT Workstation 3.51 on each.

The ten chosen test systems reflect a broad range of the hardware that readers are likely to use. They run the gamut from older 386-based systems to state-of-the-art Pentium computers. Five systems were attached to a Novell network using either Ethernet or Token-Ring adapters. The other five machines, stand-alone PCs, included two notebooks. Peripheral subsystems included an assortment of ISA, PCI, and Vesa Local Bus graphics adapters; IDE, EIDE, and SCSI hard drives; SCSI, EIDE, and parallel-port CD-

ROM drives; a variety of sound cards; and a PCMCIA modem. One network adapter card and one sound board supported the Plug-and-Play specification. We even used one drive compressed with Stacker 4.0 for DOS. Some of the equipment, such as the Teac CD-ROM drive included with the Diamond Multimedia Kit, is no longer sold but is still in active use: a common upgrade scenario.

Memory in the test systems ranged from 4MB to 32MB. In situations where memory was insufficient to load a particular operating system, we routinely increased memory to the recommended level.

To prepare the systems for the upgrade tests, we first installed one of several DOS versions and Windows 3.1 or Windows for Workgroups. Then we configured all appropriate drivers, installed test software, and confirmed that everything was functioning correctly. After we performed each upgrade test, we used an image of the preupgrade state to return each system to its original condition before beginning the



Making the Upgrade: Compatibility Test Results

SYSTEMS TESTED

HP Vectra XU 5/90C: Pentium/90, 32MB RAM, MGA Ultima Plus running at 800-by-600 with 256 colors, PCI/ISA bus, 540MB IDE hard disk, Sony CDU-76S CD-ROM drive, Proteon p1392 Plus ProNET-4/16 Token-Ring NIC, WfW, MS-DOS 6.22.

Micron 486VL: 486DX2/66, 16MB RAM, Diamond Viper VLB running at 1,024-by-768 with 65,000 colors, EISA/VL bus, 1GB EIDE hard disk, 3COM EtherLink III NIC, WfW, MS-DOS 6.21.

Compaq Deskpro 486/33M: 486DX/33, 4MB RAM, Compaq QVision running at 1,024-by-768 with 256 colors, EISA bus, 340MB IDE hard disk, Proteon p1990 Plus ProNET-4/16 Token-Ring NIC, Windows 3.1, MS-DOS 6.20.

IBM ValuePoint 466DX2/Dp: 486 DX2/66, 16MB RAM, integrated S3 864 running at 800-by-600 with 65,000 colors, ISA/VL bus, 346MB IDE hard disk, Intel Ether-Express Pro/10 Plug and Play NIC, Windows 3.1, PC-DOS.

Gateway 2000 4DX2-66V: 486 DX2/66, 8MB RAM, Diamond Viper VLB running at 1,024-by-768 and 65,000 colors, ISA/VL bus, 425MB IDE hard disk, Micro-Solutions Backpack parallel-port quad-speed CD-ROM drive, Creative Labs Vibra 16 sound card, Windows 3.1, MS-DOS 6.21.

Dell Dimension XPS P90: Pentium/90, 16MB RAM, #9GXE64 Pro running at 1,024-by-768 with 256 colors, ISA/PCI bus, 1GB EIDE hard disk, Diamond 4000 Multimedia sound card with Teac CD-55A SuperQuad CD-ROM drive, Proteon p1392 Plus ProNET-4/16 Token-Ring network adapter card, WfW, MS-DOS 6.22.

Gateway 2000 PS-60: Pentium/60, 16MB RAM, ATI graphics Xpression running at 1,024-by-768 with 65,000 colors, ISA/PCI bus, Seagate 1GB SCSI hard disk, Plextor PX-43CH CD-ROM drive, Crystalizer Plug and Play Multi-CD sound card, Windows for Workgroups, MS-DOS 6.22.

IBM PS/2 Model 70: 386DX/25, 4MB RAM, integrated VGA running at 640-by-480 with 16 colors, MCA bus, MCA 120MB hard disk, Stacker 4.0 for DOS, Windows 3.1, MS-DOS 6.0.

IBM ThinkPad 755CD: 486 DX4/75, 8MB RAM, integrated VGA running at 640-by-480 with 256 colors, Mwave sound, PCMCIA Intel Cellular fax modem, WfW 3.11, PC-DOS 6.3.

Toshiba Portégé T3400CT: 486DX/33, 8MB RAM, integrated VGA running at 640-by-480 with 256 colors, 250MB hard disk, Windows 3.1, MS-DOS 6.22.

WINDOWS 95 UPGRADE

Installation generally went very smoothly, and most hardware was supported out of the box. On all systems, Windows 95 could not locate certain components of Quicktime 1.1 and Adobe Type Manager. Reinstalling Quicktime and Adobe Acrobat fixed the problem.

System crashed on restart after installation (setup warns that this may happen) and recovered on second reboot, with no further problems.

We had problems inserting bitmaps and graphics file attachments into Lotus Notes with 65,000 colors. Notes terminated intermittently. CorelDRAW animation worked only at VGA resolution.

The system crashed during the first four installation attempts (installation was tried from the network and from the disk), but installation worked on the fifth attempt, with no further problems.

CorelDRAW animation worked only with 256 colors.

CorelDRAW animation worked only at VGA resolution. The system used real-mode drivers for the Backpack CD-ROM drive, which worked correctly.

The system did not recognize the multimedia card. We had to install real-mode drivers, which worked correctly.

DOOM II would not run. The graphics adapter was recognized as the Graphics Pro Turbo Mach 64. We had to remove drivers from the system setup, AUTOEXEC.BAT, CONFIG.SYS, and SYSTEM.INI to get installation to work. Sound did not work.

Installation informs you that the drive is stacked and not optimized for Win 95. Memory was not sufficient for OLE inserts into Notes, running Netscape, running DOOM II, or running Microsoft Word reliably.

No problems were encountered.

No problems were encountered.

OS/2 WARP UPGRADE

OS/2 Warp was the trickiest of the three upgrades, and network installation was its most problematic area. Configuring Chameleon correctly for our Netscape tests on nonnetworked systems proved difficult.

The graphics adapter was not recognized. CD-ROM drive installation required the manual addition of a driver to the installation disks. The network adapter was not directly supported. The Lotus Notes Windows client did not run.

The network adapter was not directly supported; a driver from 3COM was required. CorelDRAW animation ends by blacking out the screen at all resolutions and color depths.

Manual installation of Compaq QVision video drivers was required. The network adapter was not directly supported. We had problems receiving and saving a Gopher link.

A tech-support call was needed to get past Disk 7. The Plug and Play network card would not install until allowed to configure itself, after which we needed to disable the Plug and Play BIOS. The Quicktime movie did not run.

CD-ROM drive installation required the manual addition of a CD-ROM driver to the installation disks and manual editing of the CONFIG.SYS on the installation disk. DOOM II gives a "wrong mouse driver" error; disabling the sound drivers fixed the problem. CorelDRAW animation did not work.

The system did not recognize the graphics adapter; the fix entailed downloading drivers. Diamond Multimedia drivers are available in beta only and did not work despite many attempts. We were unable to get the OS to recognize the network adapter card with Novell's Requester or MPTS protocols. Lotus Notes Windows client did not run.

The sound card was recognized as Sound Blaster and did not work. There were intermittent GPFs when running Quicktime and CorelShow. There were problems pasting Excel OLE objects into a Word document. CorelDRAW animation did not work.

OS/2 Warp installed successfully over an OS/2 stacked drive but could not run tests with less than 8MB of memory.

No problems were encountered.

Portégé-specific PCMCIA support was not supplied.

WINDOWS NT WORKSTATION UPGRADE

Adobe Type Manager (which is required for our Netscape tests) did not work under Windows NT. We had to disable sound in the DOOM II tests. We were unable to load Corel Photo-Paint, and CorelDRAW's Export/Save feature did not work reliably.

The SCSI CD-ROM was recognized as IDE; it functioned correctly nonetheless. The network card had to be configured manually.

There were problems with full-screen capture in Corel-Capture.

No problems were encountered.

The network adapter was not recognized; the fix entailed downloading drivers. We had to disable the Plug and Play BIOS on the network card.

There was no support for the Backpack CD-ROM drive, which could not be accessed. We could not capture a full screen in CorelCapture.

The sound card was not recognized. The network adapter had to be configured manually.

We were unable to launch Corel Photo-Paint. There were problems with full-screen capture in CorelCapture.

Not applicable: Microsoft does not recommend running Windows NT on a 386 system.

The sound card was not recognized. We encountered an insufficient memory error when inserting an Excel OLE object in Lotus Notes.

We encountered an insufficient memory error when inserting an Excel OLE object in Lotus Notes.

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Dell's featured digital artist is Sanjay Kothari of New York, NY



Plug and Play: Promises Kept, Promises Pending

By Jonathan Hill

One of the most ambitious components of Microsoft's Windows 95 operating system is its Plug and Play functionality, which promises almost effortless installation of new hardware devices into your PC. If you have ever spent fruitless hours trying to get your new sound card and CD-ROM drive to work together, Plug and Play may be one of the most eagerly awaited and long-overdue components as well.

In the brave new Plug and Play world envisioned by Intel, Microsoft, and other key industry players, users armed with the right combination of hardware and software will be able to make upgrades much more easily than they have traditionally. All you need to do to install a PnP device is to connect it physically and launch Windows 95. Windows 95 then automatically configures all DMAs, IRQs, and I/O and memory address spaces, and it can even load the appropriate driver from its database automatically. The PnP standard also allows for hot or warm docking of a portable PC (which means you don't have to reboot your portable each time you pop it in or out of its docking station). All the devices you have installed (PnP and otherwise) and the resources they have been allocated are cataloged in the operating system's handy Registry, Hardware Tree, and Device Manager.

To get the full benefits of PnP, you need a PC system with a PnP BIOS, a PnP operating system (like Windows 95), and PnP-compatible peripherals. But even if you don't have all these elements, Windows 95 does help to ease installation problems. For instance, Windows 95 can usually automatically detect and configure devices added to a system that lacks a PnP BIOS. And its Add Hardware wizard can help you configure legacy devices in older systems and will, in turn, steer new

devices away from those claimed resources down the line.

As with any new technology, the road to PnPville is pocked with pot-holes, and early implementers may well run into an unmarked cul-de-sac or two. We took a detailed look at PnP support in Windows 95 and other operating systems in "Effortless Upgrades" (May 16, 1995), but relatively few of PnP's puzzle pieces were in place at that time. Real-world PnP functionality has improved tremendously over the last several months, and while Microsoft's dream of a soup-to-nuts user-friendly environment remains partially unrealized, we did find that configuring a complex system in a PnP environment can be astonishingly easy.

WHEN IT WORKED, IT WORKED

We installed—using a DEC Celebris 590 PC equipped with a PnP BIOS and

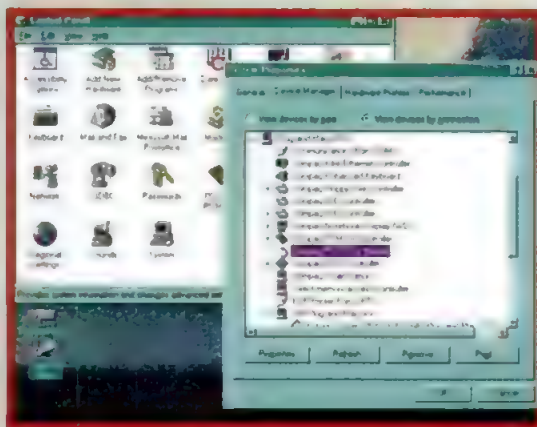
somewhat spotty Windows 95 driver support.

Installing a PnP-compliant PCI Intel Ether Express Pro into our PnP-ready Celebris went flawlessly. Windows 95 found the card, installed the driver for it properly, and automatically connected to our Novell network. No mess, no fuss.

In our non-PnP Compaq system, Windows 95 functioned admirably with both PnP-compliant and non-PnP peripherals. For example, we installed a PnP-compliant ISA-based Future Domain SCSI controller effortlessly: The OS found the controller, installed the drivers for it from the Windows 95 CD, and was able to configure the card correctly without user intervention.

More impressively, Windows 95 correctly identified our non-PnP Compaq Q-Vision graphics controller, IDE hard drive, and NEC quad-speed CD-ROM drive in the non-PnP Compaq. The system setup routine detected those new devices and triggered the Hardware Wizard. A quick walk through a few setup screens (all we had to do was click **Next** repeatedly) led us to the configuration menu. The OS knew the IDE drive name and drive type, found the NEC CD-ROM and identified it by name, and identified the Q-Vision card. Wizardry? Well, almost. Windows 95 can recognize some legacy devices by looking for scraps of code and other identifiers in likely address areas.

To test PnP's hot/warm docking capabilities under Windows 95, we employed a Compaq LTE Elite 4/75cx and its Smartstation docking unit, which are capable of executing a warm dock/undock sequence. Warm docking requires that you put the system into suspend mode, unlike hot docking, which is truly on the fly. You can trigger the event from software: Starting from an undocked configuration, simply click Suspend from the Start menu. Inserting the laptop into the docking station



Windows 95's Device Manager provides a handy list of all the hardware attached to your PC.

running Windows 95—a series of components, from ones claiming PnP compliance to older legacy cards. We also used a non-PnP Compaq Deskpro M, an EISA-based 486DX2/66 legacy system, to test Windows 95's PnP capability in the absence of a PnP BIOS. We were generally impressed with how the operating system executes the PnP mandate. In fact, our biggest complaint is not with Windows 95, but with the

brings the unit back to life.

When docked, the Suspend choice in the Start menu is replaced by the Eject menu item. Clicking on Eject puts the Compaq into suspend mode. As long as no docking station-based resources (CD-ROM, hard drive, and so forth) are in use, the system enters suspend mode and ejects the laptop, which comes back up in its new, undocked configuration.

Plug and Play for PC Cards (née PCMCIA) is relatively robust. In fact, PnP functionality for this type of peripheral already exists for operating systems that do not provide general PnP support, like Windows 3.1x, Windows NT 3.51, and OS/2 Warp 3.0.

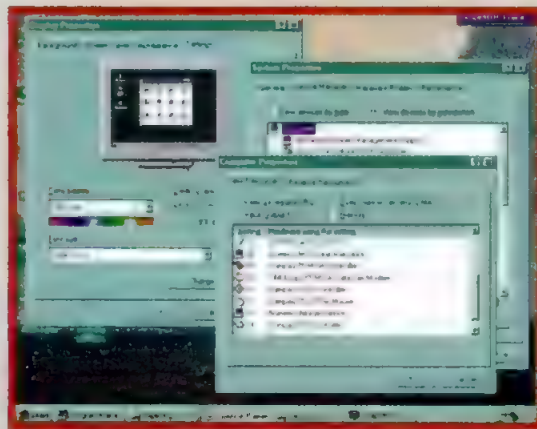
MISSED SYNAPSES

Our Plug and Play experience was not without its bumps. For example, when we installed a PCI version of Intel's Token Express Pro in the PnP-ready DEC Celebris. Windows 95 found the card and identified it properly. But Windows 95 does not ship with a driver for the Token Express Pro, and Intel didn't yet have Windows 95 drivers available. While this is a problem only until Intel ships a Windows 95 driver for the Token Express Pro, many vendors report they won't be writing new drivers for older devices because they have to concentrate on ones for their current products. The only reliable way we found to use some Windows 3.1 drivers under Windows 95 is to boot up in DOS 6.0 and Windows 3.1, run the install for your device, and then reload Windows 95. Otherwise, Windows 95 is likely to remove the device lines that you insert in your CONFIG.SYS and AUTOEXEC.BAT files.

And of course, installing a non-PnP legacy card that is not registered in Windows 95's database means doing things the old-fashioned way. The OS's Add New Hardware wizard will sometimes detect an unknown device, and you'll need to consult the peripheral's

manual to determine which settings the card can accept, then set them manually on the card and log them in the Device Manager.

On the plus side, Windows 95's Hardware Tree does let you see at a glance which resources were already taken: a big help. More interestingly, if you configure a legacy card to conflict with an already installed PnP device, Windows 95 gives the resources to the legacy card and changes the PnP com-



You can get a quick rundown of all the resources occupied by each installed device.

ponent's resources. If there's already a conflicting legacy device installed, the OS disables one of the cards (based on a most needed hierarchy: graphics cards and floppy disk drives are more important than capture cards and tape drives, for example) and indicates in the Hardware Tree that the device is disabled. You can then use the Hardware Tree information to find available resources, power down, and reset the card's jumpers as necessary. Also, Windows 95 was able to recognize that the IRQ, DMA, and memory address settings required by our old Sound Galaxy card were static resources, so that throughout our testing the OS properly assigned nonconflicting resources to the other devices on the system.

CUTTING LOSSES

Support for a couple of key PnP elements was wanting in the final release of Windows 95 that we received for

testing. For one, we couldn't test support for SCAM (SCSI Configured Automatically), a portion of the PnP SCSI spec that was designed to allow automatic selection of SCSI ID values. Microsoft reports that SCAM is enabled and fully functional for users who have SCAM-compliant devices and adapters, but that only a few certified drivers were available from manufacturers in time for the Windows 95 release.

PnP's DDC (Data Display Channel) monitor support will be disabled in the retail versions of Windows 95. Under DDC, the card and monitor are supposed to ID themselves and arrange their operating parameters (optimal resolution, refresh rates, and number of colors). In beta testing, however, Microsoft discovered that the DDC function call that Windows 95 makes to the graphics card would cause some non-DDC cards to hang the system. DDC can be enabled by systems manufacturers who ship DDC-compliant cards.

One final note: PnP does not define any new IRQs or DMA channels for the PC. When we installed multiple PnP peripherals in an attempt to overload the system, PnP properly disabled some devices in order to provide resources for other, more essential services. PnP handles this situation with considerable aplomb. In this new PnP order you can install peripherals without tearing out your hair, but there is an old AT architecture-based glass ceiling that continues to limit the number of devices you can install in any one system.

To be sure, Windows 95 and Plug and Play offer cool respite from the worst excesses of non-PnP systems. As vendors become more comfortable with the still-evolving specs and older legacy components reach the end of their useful lifespan, the list of problematic installations will shrink—and the era of slipping little bits of paper covered with IRQ, DMA, and memory address settings under your PC's cover will fade from memory.

next upgrade test.

Our test-beds were loaded with a selection of Windows applications, including Microsoft Word 6.0, Microsoft Excel 5.0, Adobe Acrobat 2.0, Apple QuickTime for Windows 1.1, CorelDRAW 3, Netscape Navigator 1.0N, Lotus Notes 3.31, and id Software's DOOM II.

We exercised a variety of functions and operations within each of the tested applications, for a total of about 60 operations. This clearly does not represent everything these programs do but is meant to provide a general overview of capability.

The overall goal of our tests was to see if we could get an OS upgrade to work correctly on each system within a reasonable amount of time. Problems that could not be settled without a significant time investment were left unresolved (we certainly do not claim that every unsolved problem was unsolvable). When problems arose, we did exactly what a normal user would do: We made calls to the operating-system vendor and technical support representatives for the applications and peripherals on the test-beds. We also visited on-line technical-support forums and downloaded drivers and patches where appropriate.

WHAT WE FOUND

In general, we found Windows 95 installed easily and worked with almost all our hardware and software straight out of the box.

OS/2 Warp and OS/2 Warp Connect presented a very different picture. OS/2 Warp appears more tolerant of touchy applications than Windows NT, but when we encountered problems, they were more difficult to diagnose and fix, despite a yeoman's effort by IBM's technical-support staff to help us find solutions.

Windows NT Workstation does not support as wide a range of devices and applications as Windows 95 or OS/2 Warp; but for the software and hardware that it supported, installation required little effort.

WINDOWS 95

Windows 95 was designed to provide good backward compatibility with 16-bit Windows applications and real-mode device drivers, while making life easy for end users during the installation process. In general, we found that it lives up to this claim. Installation went extremely well on our test systems. The only exception was

the Compaq Deskpro 486/33M, which crashed several times during installation and then, without explanation, completed installation and operated properly from that point on. The operating system detected our Plug and Play EtherExpress network card and configured it for us. But we were never able to get Crystal Computer's Crystalizer Plug and Play MultiCD sound card to work.

We were able to establish a connection with NetManage's Chameleon, but Netscape did not recognize the connection. We replaced Chameleon with Windows 95's Dial-Up Networking, and the Netscape browser worked as expected.

We were impressed that Windows 95 detected the stacked hard drive on our PS/2 and continued to work while warning us that the current version of Stacker was not optimized for Windows 95. The operating system also automatically configured itself for Netware and properly ran the login scripts.

Two of our applications, Acrobat and QuickTime, would not run after upgrading to Windows 95. Simply reinstalling them fixed the problem.

OS/2 WARP AND OS/2 WARP CONNECT

OS/2 Warp Version 3 is sold as either an upgrade for Windows 3.1x (red) or with built-in Windows support (blue). OS/2 Warp Connect is also available in both flavors. All of our non-networked systems were tested with the red release of OS/2 Warp. We initially tested the network systems with the blue version of OS/2 Warp Connect, but found that we needed to reinstall existing Windows applications for them to work properly. IBM was able to supply us with the just-released red version of OS/2 Warp Connect, which we then used on the network systems.

The OS/2 Warp installation from CD-ROM is initiated using two bootstrap disks. After loading drivers from these two disks, the operating system accesses the CD-ROM drive and finishes installation by reading files off the CD-ROM. We found that the SCSI Sony CDU-765 CD-ROM drive and the MicroSolutions Backpack CD were not supported on these disks. We had to download the required OS/2-specific driver and add it to installation-disk number 1. We also had to add a device driver statement manually to the CONFIG.SYS

file located on the same installation disk, a cumbersome process. Once we had the drivers set up correctly, basic installation was relatively easy. OS/2 Warp correctly recognized most video adapters and Sound Blaster-compatible cards.

Configuring networking was a different matter, however. OS/2 Warp did not directly support any of the network cards we used in testing. In addition, the TCP/IP drivers and Multi-Protocol Transport Services (MPTS) were spread across several disks, making configuration somewhat cumbersome. We were able to get four of our five test adapters working using the Novell requester that ships with the OS/2 Warp Connect package. But even after working through the night with IBM's priority technical-support staff, we were not able to get the Proteon 1390 Token-Ring adapter to work.

We were also unable to get the Windows version of Lotus Notes, which we had configured to run using NetBIOS, to work with either Novell's or IBM's NetBIOS versions. A fix suggested by Lotus couldn't resolve the problem. Users can use Notes Express, which ships with OS/2 Warp Connect (but does not provide full client functionality) or purchase the full OS/2 Notes client. In many cases this will be more efficient, though certain features such as the ability to use OLE objects will not work.

When we installed Warp's TCP/IP support, it created a file called RESOLV2 that stores the address of the name server. This allows the use of Internet names rather than addresses. A copy of this file must be placed in a separate directory in order for DOS and Windows programs to use names. This copy was not made automatically, however. IBM's Technical Support instructed us how to copy the necessary file to the appropriate directory and directed us to download a patch from IBM's FTP site. Once this was done, Netscape worked as expected.

OS/2 Warp defaults to RestartObjects=Yes so that your desktop and any open sessions are automatically restarted each time you restart the operating system. In theory, this is a very convenient feature. But as we found out, this can also restore problems. For example, during a Lotus Notes remote session, the system locked. Then each time we restarted the system, OS/2 restarted Notes in an incorrect state,

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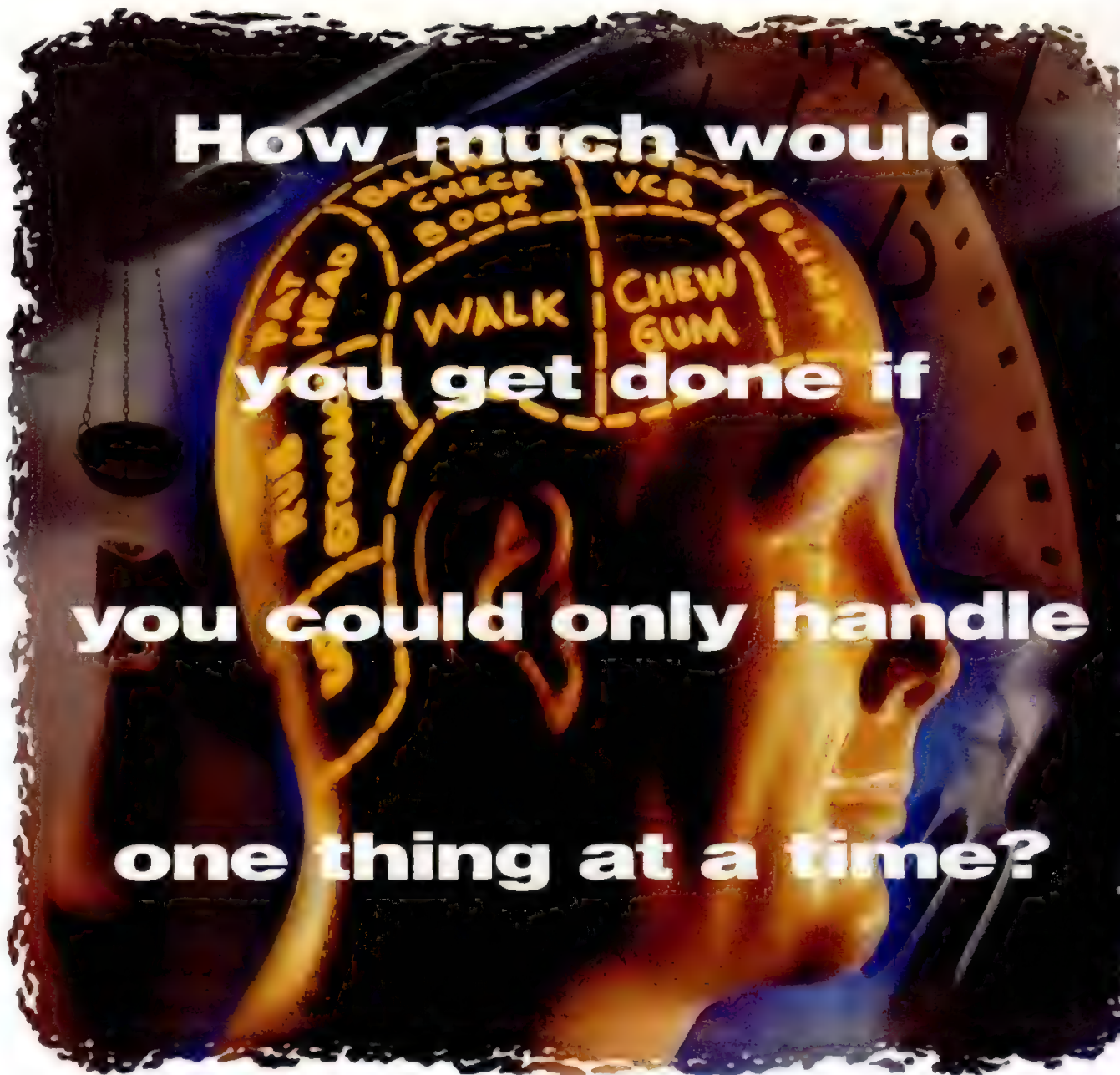
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preventing access to the COM port.

The only way around this is to clean-boot the system by pressing Alt + F1. This provides several recovery options, including restoring your system to its original installation state. Unfortunately, if you choose this option, any customization that you have performed will be lost. To avoid this problem, we had to make a copy of the CONFIG.SYS, OS2.INI, and OS2SYS.INI files before restarting. Once we restored the system to its original state, we copied these files back. The system then worked properly as customized. To avoid this annoying problem in the future, we disabled the Auto Restarting Objects setting.

WINDOWS NT 3.51

Microsoft positions Windows NT Workstation as designed for reliability first, not compatibility. This can make it a problematic environment for running utilities and other applications that attempt to write directly to the hardware.

An example of this is CorelDRAW 3.0. This program uses 16-bit drivers that are incompatible with Windows NT for creat-

ing color-image headers. This prevented us from saving native .CDR files in that format. Other 16-bit drivers are used extensively throughout CorelPhoto-Paint, and we were unable to run it, either. No amount of tweaking will fix this problem. The application vendor must rewrite offending portions of its code to achieve compatibility with Windows NT (Corel has fixed these problems in CorelDRAW 5.0.)

Another problematic product was Adobe Type Manager 2.0. Programs that rely upon ATM, such as Adobe's own Acrobat (used as part of our Netscape testing), will also not be able to run. And we had to use the Microsoft Remote Access Services rather than NetManage's Chameleon for dial-up to the Internet, as Chameleon did not work on Windows NT.

Unlike Windows 95, Windows NT cannot access hardware using real-mode device drivers. If 32-bit Windows NT drivers are not available, the device will not work. Our MicroSolutions Backpack parallel-port CD-ROM and Diamond Multimedia adapters would not work, nor would the built-in Mwave sound adapter in the IBM

ThinkPad 755CD. We were unable to locate Windows NT drivers from the vendors for any of these devices.

Windows NT installation was reasonably easy, and we installed it both from a CD-ROM and across the network. Installing the network support was a bit confusing, however. You must select Custom Installation to be able to add additional client software.

Windows NT does not support Plug and Play. We had to disable Plug and Play on our Intel EtherExpress Pro/10 to install the adapter successfully. It provided drivers for most of our adapters, and configuring them was straightforward.

We found that Windows NT's graphics adapter drivers are generally more generic than those provided by Windows 95. Typically, it identified a card by chip set rather than by the specific adapter model. Still, we were able to run each of the systems at the desired resolution and color depth.

Once Windows NT was installed, the applications on our test systems worked properly, with the few exceptions noted here and in the summary table. □

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P E N T I U M 1 2 0 s / 1 3 3 s

SETTING THE PAGE

The fastest PCs you can buy—those based on Intel's 120- and 133-MHz Pentium processors—offer breathtaking performance. Yet they're not as expensive as you might expect. PC Magazine Labs tests 66 high-end systems to find the best.

By Robert S. Anthony

The Pentium processor was introduced by Intel Corp. with thunderous fanfare in 1993. Overcoming early criticisms about excessive heat and large power demands in the 60- and 66-MHz versions, as well as the more recent rush of bad publicity from its now-corrected floating-point-unit flaw, it has since enjoyed a long and fruitful reign as the top banana among mainstream PC processors.

Despite the impending introduction of the P6, the code name for Intel's sixth-generation PC processor, the Pentium will remain the mainstream CPU of choice. In a recent story (see "P6: The Next Step?", September 12, 1995), we took a close look at the P6; it turns out that Intel's next-generation processor is optimized to run 32-bit applications and 32-bit operating systems such as Microsoft Windows NT. When running existing 16-bit code, it can actually be slower than a Pentium. And even with 32-bit applications on Microsoft Windows 95, it will offer only a

► IN THIS REVIEW

Vendors of products reviewed:		
Acer America Corp.....	192	Gateway 2000 Inc.....
All Computer Warehouse.....	195	GST/Micro City.....
American MultiSystems.....	195	HD Systems Inc.....
AST Research Inc.....	195	Hewlett Rand Corp.....
AT&T Global Information Solutions.....	200	HiQ Computer Systems.....
Compaq Computer Corp.....	200	Hymco Technologies Inc.....
CompuTrend Systems Inc.....	201	IPC Technologies Inc.....
Comtrade.....	204	Maximus Computers.....
Dell Computer Corp.....	205	Micron Electronics Inc.....
DFI.....	206	MidWest Micro.....
Digital Equipment Corp.....	206	Mitsuba Corp.....
DirectWave Inc.....	211	Multiwave Technology.....
DTK Computer Inc.....	212	National MicroComputers.....
Ergo Computing Inc.....	212	NETIS Technology Inc.....
Everex Systems Inc.....	212	Percomp Microsystems Inc.....
		Polywell Computers Inc.....
		Quantex Microsystems Inc.....
		Reason Technology Inc.....
		Royal Computer Inc.....
		SAG Electronics.....
		Sys Technology Inc.....
		Tagram System Corp.....
		Tangent Computer Inc.....
		Tatung Company of America Inc.....
		Tri-Star Computer.....
		Unitek Technology Inc.....
		USA Flex.....
		Vektron International Inc.....
		Zenith Data Systems.....
		Zenon Technology Inc.....
		System Performance by Processor Type ..
		Price/Performance Index ..
		Performance Tests.....
		Summary of Features ..

marginal performance boost. As a result, the 120-MHz and 133-MHz Pentium PCs reviewed here should have long and useful lives on your desktop.

GOLDEN YEARS

If you had asked your boss for a 66-MHz Pentium PC in 1993, you might have expected laughter. At that time, such PCs were considered overkill for all but the most CPU-intensive tasks, especially with prices averaging \$5,000. Today Pen-

tium/66 CPUs are nearly gone. Pentium-powered desktops now cover the price and user spectrum, ranging from affordable 75- and 90-MHz entry-level units to 120- and 133-MHz power systems for high-end tasks.

You should find that performance gains are more than commensurate with price trade-offs: With average prices for Pentium/75 systems and Pentium/133 PCs at \$2,700 and \$3,750, respectively, the near-40 percent premium for Pentium/

133 units buys you a 60 percent boost in performance. Just down the road is a 150-MHz Pentium processor; after that, we expect at least one or two more iterations of the Pentium from Intel, most likely 166- and 180-MHz versions.

NexGen processors have already set themselves up as Pentium competitors (see "Tapping the Promise of the Pentium," May 30, 1995). By the time you read this, the Pentium CPU should face additional competition from Cyrix Corp.'s 5x86 (alias

HIGHLIGHTS

120- and 133-MHz Pentium PCs

Faster Pentium PCs just keep coming: Systems based on 120- and 133-MHz processors offer nearly double the performance of 1993-era PCs using the original 60- and 66-MHz chips. And these speed demons aren't as expensive as you might think; 17 of the 66 machines we tested sell for under \$3,000 fully configured.

MEMORY SUBSYSTEMS hold the key to optimal performance. The fastest machines combined synchronous L2 cache with EDO (extended data out) DRAM to minimize wait states. We discovered that omitting L2 cache altogether can have a devastating effect, dropping performance to half that of the leaders.

GRAPHICS-BOARD VENDORS, always striving to wring additional

speed out of the display subsystem, have begun employing novel technologies to boost performance. Number Nine's Imagine 128 card has a 128-bit data path between the accelerator and the frame buffer—twice that of most cards—while the Matrox Millennium uses new WRAM (Window RAM) chips. Still, the best-performing card on our tests was the Diamond Stealth 64 Video VRAM, based on S3's speedy new Vision968 chip set.

SCSI IS CLOSING IN on Enhanced IDE: After a yearlong reign as the undisputed performance leaders, E-IDE hard disks have been trounced by new SCSI solutions that allow 32-bit disk access under Microsoft Windows. E-IDE remains less expensive and easier to use, however.

WINDOWS 95 SUPPORT remains an unknown with these systems; Microsoft released the operating system after we had completed our testing. Expect vendors to update BIOSes to provide more stable Plug and Play support; look for a machine with a reprogrammable flash BIOS, in case you need a change.

LOOKING AHEAD, Intel promises to release 150-MHz Pentiums by year's end, and faster versions are likely next year. Don't expect the Pentium to be eclipsed by Intel's next-generation P6 processor—the P6 is designed to run still-scarce 32-bit applications and 32-bit operating systems such as Microsoft Windows NT. Its performance with existing 16-bit apps and under Windows 95 will be unimpressive.

M1sc) CPU as well. Cyrix said a 100-MHz version of the 5x86 chip, which it claims is comparable to a 75-MHz Pentium, will be ready to ship in the fall.

The 5x86 is a lower-cost derivative of Cyrix's M1 CPU, lacking the M1's super-scalar capabilities and using only a 32-bit data bus (the P6 bus, by contrast, is 64 bits wide). The full-fledged M1, which will be compatible with Pentium motherboards, will be available in limited quantities during the third quarter and will offer performance superior to a Pentium's, according to Cyrix.

Advanced Micro Devices is scheduled to release the K5, its own Pentium challenger, in very limited quantities in late 1995, and to begin volume shipments in early 1996.

REVIEW CRITERIA

We asked for machines with single 120- or 133-MHz Pentium CPUs or NexGen Nx586-P120 processors. Of the 66 units we received, 29 came with 120-MHz Pentium CPUs and 37 had 133-MHz Pentium processors. No NexGen-based units were shipping in time for our deadline.

All PCs in this review had to come with 16MB of RAM, a level we consider reasonable for today's Microsoft Windows 3.1 software as well as forthcoming Windows 95 applications. Tested systems had to have a hard disk capacity of at least 1GB, a CD-ROM drive, and an SVGA graphics adapter. We also required sound cards (or integrated audio) and speakers because we find that fewer users are sitting silently in front of their PCs.

NO-SHOWS

Notable by its absence here is IBM Personal Computer Co., which did not have 120-MHz or 133-MHz PCs ready in time for this review. Also not represented in this review are Hewlett-Packard Co. and NEC Technologies, which opted not to participate, and ZEOS International, which was in the middle of a product revision at the time of this roundup. ZEOS was recently acquired

Tangent MediaStar 5120 Tangent MediaStar 5133

It should be no surprise that machines based on Intel's newest Pentium processors are reaching new heights of performance. Better yet, the systems cost less than you might imagine.

Our Editors' Choices, from Tangent Computer, are perfect examples. The 133-MHz Tangent MediaStar 5133 was the second-fastest PC we've ever tested, with a Winstone 95 score only a point lower than the record-setting leader in this roundup. The MediaStar 5133's \$3,295 price includes a welcome extra, too: a 17-inch ADI monitor.

The 120-MHz Tangent MediaStar 5120 was no less impressive. It was one of the fastest 120-MHz machines we reviewed, and only slightly slower than the fastest 133-MHz systems. The MediaStar 5120 costs only \$2,795, making it one of the least expensive machines in this roundup. (If you equalize the monitors on the Tangent machines, their price difference exactly matches their performance difference on our Winstone 95 tests—7 percent.)

The Tangent machines offered a few design touches we liked, too. For example, audio cables are routed through the case to front-panel ports, which means you don't have to reach behind the machine to plug in headphones or a microphone, or to adjust speaker volume. Both Tangent

PCs are backed by three-year warranties that include the first year of on-site service at no additional charge.

HONORABLE MENTION

Deciding on the Editors' Choices was a tough call. A number of other systems were close contenders, and these machines earn honorable mentions.

Sys Technology's Performance P133T, the fastest machine we tested, was still aggressively priced at \$2,889. It used the same 1GB hard disk as the Tangent 5133, but it did not have a 17-inch monitor, and it included only a one-year warranty with on-site service a \$195 option.

We also liked the Gateway P5-120 Best Buy, which offers a remarkably complete package for its \$3,079 price: In addition to the 16MB of RAM and 1GB hard disk we required, it includes a 17-inch monitor and a 28.8-Kbps fax modem. And the system's performance was solidly above average for a 120-MHz machine. The Gateway P5-133 XL came with incredible components but was not cheap at \$3,999.



by Micron Technology, and both companies will continue to market systems under their own brand names.

MONEY FOR NOTHING?

Is it worth your hard-earned dollar to opt for a 133-MHz Pentium machine, or does

it make sense to save a few bucks and get almost the same level of performance from a 120-MHz Pentium unit? From what we see here, it's often a hard call.

A good example is Tangent Computer's \$3,295 133-MHz Pentium-based MediaStar 5133 and its \$2,795 MediaStar 5120; both are Editors' Choice winners and have nearly identical configurations. Remove the 17-inch monitor (roughly \$300) from the MediaStar 5133 and there is only a \$200 difference—7 percent—between the two units. The Pentium/133 PC,

Our Contributors: ROBERT S. ANTHONY is a senior writer and WILLIAM P. FLANAGAN is a staff writer at *PC Magazine*. CAROL VENEZIA is an associate editor at *PC Magazine*. CADE METZ and ANUSH YEGYAZARIAN are staff editors at *PC Magazine*. MARY E. BEHR is an editorial researcher at *PC Magazine*. JOHN CLYMAN was the associate editor in charge of this story, and RICHARD FISCO was the project leader.

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Processor	486DX 2/66	Pentium 90MHz	Pentium 133MHz
Processor Upgradable	Yes	Yes	Yes
Std./Max. Memory	8MB/136MB	16MB/192MB	16MB/192MB
Hard Drive	630MB	1GB	1GB
Cache Internal	8KB	16KB	16KB
Cache External	256KB (optional)	256KB	256KB
Local Bus Graphics	PCI	PCI	PCI
Video Memory/Max.	1MB/2MB	1MB/2MB	1MB/2MB
Compaq 150 Color Monitor	Yes	Yes	Yes
Diskette Drive	3.5" 1.44MB	3.5" 1.44MB	3.5" 1.44MB
Expansion Slots (Total)	3	4	5
Drive Bays (Total)	3	4	5
Ports: Serial/Parallel	1/1 (ECP)	1/1 (ECP)	1/1 (ECP)
Security Features	Yes	Yes	Yes
101-Key Keyboard, Mouse	Yes	Yes	Yes
Software	Windows 95 or MS-Windows® 3.1	Windows 95 or MS-Windows 3.1	Windows 95 or MS-Windows 3.1
Energy Star Compliant	Yes	Yes	Yes
Warranty†	3-Year	3-Year	3-Year
Price*	\$1,699	\$2,749	\$3,329

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which had extra cache (512K versus 256K) yielded a 7 percent increase in performance over the MediaStar 5120. Moral: Sometimes you really do get what you pay for.

OUT OF TUNE

As our benchmark tests reveal, it takes more than a powerful CPU to make a well-tuned PC. AT&T's Globalyst 380 TPC, a 120-MHz Pentium unit, was an unfortunate case in point.

For starters, it was one of only two systems here (the Compaq unit was the other) that used Windows 3.1 instead of Microsoft Windows for Workgroups 3.11, which offers disk-performance-enhancing 32-bit file access. (Compaq does not offer WfWG 3.11 as a preinstalled option.) The 380 TPC used a VLSI PCI support chip set which, PC Labs has found, does not match the performance or features of Intel's Triton chip set used on most other reviewed machines. Finally, the system used an integrated graphics subsystem and was the only one we tested that had no secondary cache. Most units reviewed had 256K or 512K of L2 cache and graphics boards that were more powerful. The net result of AT&T's component and software choices was that the 120-MHz Pentium system produced a Winstone 95 score that was more than 10 percent lower than the average score of the 75-MHz Pentium PCs reviewed in our roundup of May 30, 1995.

Performance may not be the whole

RECENT REVIEWS

► Your Portable Persona

August 1995page 102
80 color notebooks.

► Tapping the Promise of the Pentium

May 30, 1995page 102
100 Pentium and Nx586 PCs.

► Multimedia Marvels

April 25, 1995page 189
7 notebooks equipped with
CD-ROM drives.

story for some users, however. AT&T markets this system on the strength of its telephony features, and in this respect the machine shines. From a single command center you can access the unit's full-duplex speakerphone and sophisticated voice, data, and fax software. (AT&T's Globalyst 730 offers even more advanced telephony features.)

Compaq Computer Corp. faces a similar dilemma with its Pentium/120 Deskpro XL 5120 Model 1050/MX. The system's performance was uninspired, barely within the average range on our Winstone 95 tests, but it includes several non-performance-related features that corporate buyers may value. It offers integrated Ethernet and SCSI support, as well as Compaq's business audio. The latter provides some voice-recognition features and includes the Vocalyst keyboard, which integrates a

speaker, volume thumbwheel, and microphone and headphone jacks.

Calculating the benefits of these features is not straightforward. Despite slower performance, are systems with these features worth \$500 more than faster systems that lack them? Is a premium as high as \$1,000 or \$1,500 reasonable? Compaq opts for the latter, pricing its

system over \$5,000, whereas average system prices in this review were about \$3,500. AT&T made the choice easier by bringing out its system at around \$3,000.

CHANGING FACE OF RAM

Just last year, *EDO* (extended data out) DRAM was impractical because chip-set support was lacking. But in this roundup, 40 of the 66 PCs use this type of system RAM, which we have found contributes to scores on our CPUmark₁₆ test that are about 5 percent faster than those from PCs with standard DRAM. With the cost for the two technologies now about the same, there's no reason not to use the speedier RAM if your motherboard's chip set supports it.

A far more effective performance enhancement comes from *synchronous SRAM* cache. Synchronous SRAM, as the name suggests, is synchronized to match the system clock speed—meaning 60-

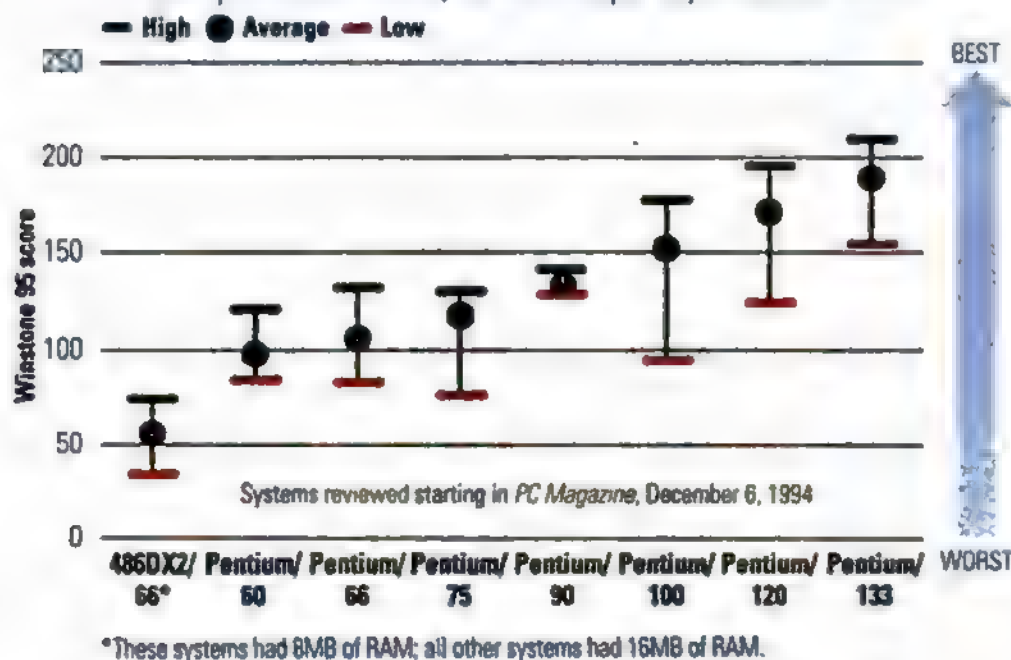
*The top five Winstone
95 performers in both
the 120-MHz and 133-
MHz processor groups
used synchronous
SRAM cache.*

MHz in Pentium/120-based motherboards and 66-MHz in Pentium/133 PCs. Among other features, it allows for a faster burst-transfer mode than standard asynchronous SRAM cache. We've seen performance increase by as much as 10 percent on our CPUmark₁₆ tests with synchronous SRAM. Synchronous SRAM has been more expensive than asynchronous, and numerous vendors have chosen the latter as a cost-saving measure. This reasoning is no longer as sound: With the advent of pipelined-burst synchronous SRAM, the price gap between synchronous and asynchronous cache has closed and the performance edge remains.

These performance benefits were also clearly borne out on our Winstone 95 tests. Of the five top-performing units in each processor class, all used synchronous

System Performance by Processor Type

The best 133-MHz Pentium systems broke records on our Winstone 95 tests, outperforming the best 120-MHz systems by 7 percent. Within each processor class, external processor cache was the crucial factor. All top-scoring systems used synchronous SRAM, not the cheaper asynchronous SRAM.



PC
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EDITORS' CHOICE
AUGUST 1995
TI TravelMate 5000
75MHz Pentium TFT



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**TEXAS
INSTRUMENTS**

CIRCLE 353 ON READER SERVICE CARD

SRAM. The top Winstone 95 scores in this roundup went to two Pentium/133 machines that used extra-fast 8-nanosecond synchronous SRAM—Sys's Performance P133T and Tangent's MediaStar 5133—instead of 15-ns synchronous SRAM.

WRAM DEBUTS

One new technology seen in this roundup is *WRAM* (Window RAM), a new type of video memory developed by Samsung Corp., which bills WRAM as being faster and cheaper than VRAM. (Although Window RAM is designed to provide high performance for graphical user interfaces, it has no direct relationship to Microsoft Windows.) Like VRAM (video RAM), WRAM is dual-ported, which means that it can move data in and out simultaneously, thus enhancing performance. Standard DRAM is single-ported. WRAM also concentrates more memory on a single chip, allowing manufacturers to use one WRAM chip instead of two VRAM chips to install the same amount of memory. Samsung is currently the sole supplier of WRAM.

The first WRAM graphics board out of the chute is the Matrox MGA Millennium. Historically, Matrox graphics cards have posted high scores on our Windows-based video tests and abysmal results on our DOS Video tests. However, the four units that used the Millennium posted great Graphics WinMark 95 and DOS Video scores. The Millennium board with 2MB of WRAM was used in Digital Equipment Corp.'s Celebris XL 5133, Gateway 2000's P5-120 Best Buy and P5-133 XL, and Tagram System Corp.'s Thunderbolt P-133E.

Within the two processor classes, it was PCs equipped with Diamond Stealth 64 Video VRAM and Number Nine Imagine 128 graphics boards that grabbed most of the top-five spots on our Graphics WinMark 95 tests. Two Pentium/133 systems using the Matrox cards with the Window RAM did take two of those spots, however.

No units with motherboard-integrated graphics subsystems fared well on our graphics tests.

SCSI ON TOP—THIS TIME

We've found that when it comes to hard disk interfaces in Pentium workstations,

Though Pentium/133 PCs in this story are faster and generally more feature-rich than their 120-MHz counterparts, two of this roundup's price/performance leaders are Pentium/120 systems.

One of the most attractive price/performance options, Tangent Computer's MediaStar 5120, was also one of our Editors' Choices. Priced to move at \$2,795 (one of the lowest prices in this roundup), the MediaStar 5120 is one of the fastest Pentium/120 we've ever tested. Its great performance and price are complemented by a three-year warranty and some of today's fastest components, such as EDO DRAM, 256K of synchronous L2 cache, a Triton chip set, a 1GB Fast ATA-2 hard disk, and the Diamond Stealth 64 graphics card. Design successes such as audio cables routed through to the front of the case add to the MediaStar 5120's appeal.

Royal Computer's Pentium/133-based Media Master owes its impressive price/performance ratio to a \$2,895 price, a 6X CD-ROM drive, a 17-inch monitor, the Diamond Stealth 64 graphics card, and good performance.

Zenon Technology's Dream Media P5-120 is the fastest Pentium/120 we've ever tested and an excellent value at \$2,949. It had the best Winstone 95 score in its class and above-average Disk WinMark 95 and Graphics WinMark 95 scores. The Dream Media 120 has the same components as the MediaStar 5120.

The other Editors' Choice winner, Tangent's \$3,295 MediaStar 5133, offers the same great performance, design, and components found in the MediaStar 5120 and adds a 17-inch monitor. This combination earned it one of this roundup's top-ten price/performance ratios.

it no longer makes much difference if the hard disk uses a SCSI-2 or an IDE interface. Enhanced IDE and ATA-2 IDE hard disks are generally cheaper and easier to install than SCSI-2-based disks, especially with most of today's Pentium motherboards offering integrated local-bus IDE connectors. In recent roundups,

Price/Performance Index

Gateway's P5-133 XL earned the top score for performance and features. It came with all the right components—a Triton chip set, EDO DRAM, 256K of synchronous L2 cache, a Matrox Millennium graphics card, and a three-CD changer—backed by a three-year-parts, one-year-labor warranty. It achieved above-average scores across our Windows-based tests. But its \$3,999 price kept it from being an overall price/performance leader.

Two units tied for the second-highest score for performance and features, IPC Technologies' Austin Power Plus 133 and Reason Technology's \$3,895 Reason Square 5 LX-TR/IE-133. IPC's unit costs \$1,000 more than Gateway's P5-133 XL and justifies the price with an additional 2MB of graphics memory, a 6X CD-ROM drive, and a slightly more robust warranty: three years on parts and labor. Reason's system includes many of the quality components found in the other units *and* an unprecedented six-year parts-and-labor warranty.—
Analysis written by Mary E. Behr

THE DATA POINTS

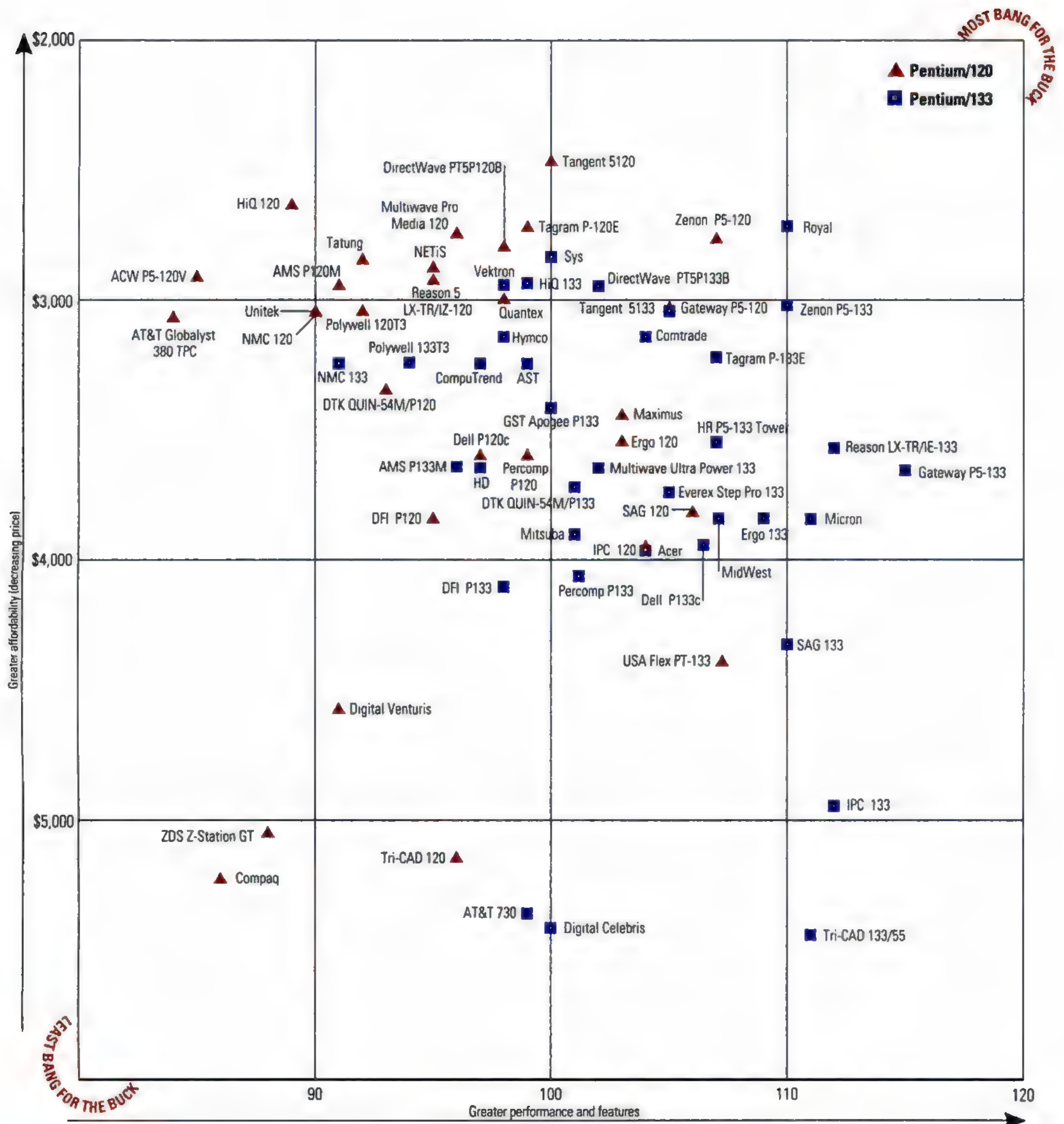
Scores on our benchmark tests—primarily our Winstone 95 tests—account for just under half of the total score for performance and features. Warranty terms, technical-support service, and ratings from our Service and Reliability survey account for almost 10 percent. Features, components, and expandability make up the remainder of the score.

Price/performance index data is available in the Hardware Library of the Editorial Forum on PC MagNet under 16BANG95.TXT and on the World-Wide Web at <http://www.ziff.com/~pcmag/pclabs/pclabs.htm>.

machines with IDE hard disks have been the performance leaders on our Disk WinMark 95 tests.

But in this story, two SAG Electronics PCs, the STF 133 and STF 120, used SCSI-2 hard disks to garner the top Disk WinMark 95 scores in their CPU classes. Each unit used a 2GB Quantum XP32150W

PCs
120- and 133-MHz Pentium PCs



SCSI-2 hard disk and an Adaptec AHA-2940W PCI controller card.

The introduction of 32-bit Windows drivers for SCSI-2 disks made this level of performance possible. These new drivers allow the disks to perform data transfers in Windows protected mode without having to switch into the DOS real mode, a

time-consuming task that drags down performance. IDE hard disks have had these types of drivers for some time.

Note, too, that hard disk capacity alone can enhance a PC's performance. A half-filled 2GB hard disk can find, read, and write data faster than a full 1GB disk because the head doesn't need to move as

far. Larger-capacity hard disks frequently have faster rotation rates as well, which also boosts performance.

Other top performers on our Disk WinMark 95 tests were the 12 reviewed systems that used 1GB Quantum Fireball 1080A Fast ATA-2 hard disks. All of these units relied on motherboard IDE connections.

Although it hasn't been that long since CD-ROM drives became standard equipment on mainstream PCs, the drives have been gaining speed at a surprising pace. In our December 7, 1993 roundup of 486-class PCs, only a handful of systems featured even single-speed CD-ROM drives. Today, the double-speed CD-ROM drives that were considered speed demons a year ago are all

Vendors are improving their service-and-support offerings in an effort to differentiate themselves and their systems.

but gone. A very small price difference is one reason why double-speed drives have been so quickly replaced: We've seen as little as \$5 separate systems with quad- versus double-speed drives. Among our tested systems are nine machines with Plextor's new sextuple-speed CD-ROM drive, which features a data-transfer rate of 900 KBps.

Two machines—AST's Bravo MS

P133 and Compaq's Deskpro XL 5120—were tested with double-speed CD-ROM drives, but only because the original quad-speed CD-ROM drives they arrived with had driver conflicts with our test software.

STEPS UP IN SERVICE

With commonalities among hardware systems on the rise, vendors are beefing up service-and-support policies in an attempt to set themselves apart. Gateway 2000 is now offering 24-hour, 7-day telephone technical support for its PCs. Reason Technology supports its machines with a six-year parts-and-labor warranty. And Percomp MicroSystems offers 24-hour, 7-day support for both hardware and software—even if you didn't buy the software from Percomp originally.

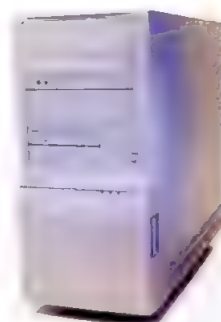
MOVING FORWARD

Soon, the Pentium will no longer be number one in Intel's processor lineup. But for the time being, 120- or 133-MHz Pentium PCs offer affordable, top-level CPU power that will place you—temporarily—well ahead of the demands of mainstream software. Indeed, reports of the Pentium's death have been greatly exaggerated. We think there's a whole lot to like in the 66 products from 45 vendors that we have reviewed here.

Acer America Corp.

AcerPower

Judging from the consistently good performance of the AcerPower, its street price of \$3,995, and the quality of its components and software bundle, we have to conclude that Acer America clearly has a good idea of what business users are looking for and has built a system to suit this market. Acer also sells the Acer-Across line of PCs, aimed at home users, through the retail channel.



IN SHORT

The 133-MHz AcerPower brings average performance to the business market for which it is designed.

SERVICE & RELIABILITY Acer America Corp.

Reliability	Average
Repair	Average
Technical support	Average
% needing repair	Average

The Pentium/133-based mini-tower system's motherboard features a Triton chip set and EDO DRAM. Some of the unit's features include a 1.5GB hard disk, a quad-speed CD-ROM drive, and a 17-inch monitor. Microsoft Office is also bundled with this

system, solidifying its place as a business machine. One minor caveat: The unit's speakers are relatively underpowered; you may want to upgrade to Yamaha speakers for \$79.95.

The AcerPower's scores on our benchmark tests were fair. Its Winstone 95, Disk WinMark 95, and Graphics WinMark 95 scores were all well within the average of scores posted by other systems in the Pentium/133 group.

Acer backs the unit with a three-year warranty on parts, with labor and on-site service covered for the first year. Acer also offers 24-hour, 7-day telephone technical support.

—William P. Flanagan

120- AND 133-MHz PENTIUM PCs

In Short and Service & Reliability Ratings

The **IN SHORT** statement conveys our impressions of the systems covered—what their distinguishing features are and how well they meet the requirements of their target audiences.

The **RELIABILITY** rating is a measure of respondents' satisfaction with the reliability of machines from the vendor in use over the past two years

The **TECHNICAL SUPPORT** rating is a measure of respondents' satisfaction with the vendor's technical support for machines in use over the past two years

IN SHORT

Well-priced corporate workstations with sterling performance for the business market

SERVICE & RELIABILITY

Vendor Name

Reliability	Better than average
Repair	Average
Tech support	Average
% needing repair	Worse than average

SERVICE & RELIABILITY ratings are included for vendors that received at least 50 responses in our latest poll of 17,000 subscribers. These results reflect readers' experience with all desktop PCs from a given vendor. For details, see our issue of July 1995

The **REPAIR** rating is a measure of respondents' satisfaction with the repair service provided by the vendor for machines in use over the past two years

The **PERCENT NEEDING REPAIR** rating is a measure of the proportion of machines that respondents indicated needed repair in the first year of use.

Acer America Corp., San Jose, CA; 800-733-2237, 408-432-6200; fax, 408-922-2933.

Circle 442 on reader service card

All Computer Warehouse

ACW P5-120V

The ACW P5-120V, from direct distributor All Computer Warehouse, provides average performance and is attractively priced at \$2,964. Instead of targeting a particular market, the vendor customizes the unit with a home- or business-oriented software bundle to suit its customers.

The unit we tested came with the vendor's home bundle, which includes Microsoft's Entertainment Pack (Microsoft Encarta '95, Microsoft Money, and Microsoft Works) as well as a few games packages. The company's business-oriented bundle includes Microsoft Office, which is an additional \$195.

This Pentium/120 desktop PC was configured with a 1GB hard disk, a quad-speed CD-ROM drive, and a 16-bit audio card capable of both FM and wavetable synthesis. Its 15-inch monitor keeps the price low, but some may find that monitor size limiting for a system at this level. The unit also features an ISA/PCI-based motherboard with a Triton chip set and EDO DRAM, and a graphics subsystem based on an S3 Vision968-equipped Diamond Stealth 64 graphics accelerator.

The unit had good performance, posting average scores for its class

IN SHORT

An affordable, consistent performer, the ACW P5-120V is appealing, though it has a short warranty.



ty. On-site service is available for an additional \$109.95.—WPF

All Computer Warehouse, City of Industry, CA; 800-775-1953, 818-369-4181; fax, 818-961-7462.

Circle 443 on reader service card

American MultiSystems

InfoGold P120M InfoGold P133M

The \$2,995 InfoGold P120M and the \$3,695 InfoGold P133M (both prices are street prices), from American MultiSystems, are relatively affordable. But while the P120M was a competent Windows performer for the most part, the P133M faltered on our Winstone 95 and Windows disk tests because of an inefficient disk connection. AMS targets home multimedia users with the P120M and aims the P133M at the business market.

Both systems come with 1.2GB Conner CFS 1275A hard disks, quad-speed CD-

IN SHORT

The InfoGold machines are well equipped, although a configuration problem slowed the P133M.



The P120M was basically a good performer, with average Winstone 95 and Graphics WinMark 95 scores. Its Disk WinMark 95 score was well below its CPU group's average, however.

The P133M did not fare as well. Although the system's Graphics WinMark 95 score was average, its Disk WinMark 95 score was the lowest in its class and also pulled its Winstone 95 score to below average because of its slow Conner hard disk.

The American MultiSystems machines are backed by a one-year warranty that covers parts and labor. Users may purchase on-site service for an additional \$75.—WPF

American MultiSystems, Milpitas, CA; 800-888-6615, 408-945-2296; fax, 408-945-2299.

Circle 444 on reader service card

AST Research Inc.

Bravo MS-T P133

The Pentium/133-based AST Bravo MS-T P133 represents the high end of AST's Bravo line of corporate PCs. This unit has an attractive street price of \$3,350, but an odd design makes the system difficult to service and it was a poor performer on our tests. AST also offers the Advantage line of home systems and the Premmia line of high-end corporate workstations targeted toward CPU-intensive applications running on 32-bit operating systems such as Microsoft Windows NT (neither reviewed here).

The Bravo's motherboard has a riser card, and its expansion cards hang upside down. To add or swap cards, you must remove the case housing and bottom cover and flip the unit on its side.

ATI Mach 64 graphics and 16-bit audio chip sets are integrated on the motherboard; our unit came with a Creative Labs 16-bit sound card as well. Speakers were not included because AST feels that headphones make more sense in a business environment. Though the Bravo originally had a quad-speed CD-ROM drive—the standard configuration, costing only \$5 more—its drivers had conflicts with our tests, and the drive was replaced with a double-speed device.

The unit posted below-average scores on all Windows-based tests. The unit's SIS chip set, which does not support EDO DRAM or pipelined-burst cache, contributed to these results.—WPF

AST Research Inc., Irvine, CA; 800-876-4278, 714-727-4141; fax, 800-926-1278.

Circle 445 on reader service card



IN SHORT

Awkward design and poor performance diminish the attractiveness of the Bravo's price.

SERVICE & RELIABILITY

AST Research Inc.

Reliability	Better than average
Repair	Better than average
Tech support	Average
% needing repair	Better than average

Benchmark Tests: 120- and 133-MHz Pentium PCs

Pentium/133 systems set records on our benchmark tests, but Pentium/120 machines weren't far behind. Credit goes to synchronous L2 cache, EDO DRAM, a new generation of graphics cards, and ultrafast hard disks.

What the Numbers Mean

There is significant overlap among the scores for Pentium/120 and Pentium/133 systems. But the numbers do offer one consistent message: Choosing the right support components, from core-logic chip sets to hard disks and graphics accelerators, is critical to maximizing performance.

WINSTONE 95

On our Winstone 95 tests, poor component choices proved devastating for one machine. AT&T's Globalyst 380 TPC was the only unit here that lacked L2 cache altogether, resulting in an abysmal Winstone 95 score of 105—about as fast as a typical Pentium/60 PC. (The Globalyst 380 TPC was also one of only two machines that did not use Microsoft Windows for Workgroups 3.11, which provides a high-speed 32-bit file cache not available in Microsoft Windows 3.1.)

At the top of the heap, the four Pentium/133 machines that nearly tied for first place—Sys Technology's Sys Performance P133T, Tangent Computer's MediaStar 5133, Comtrade's HyperSpeed MPEG Multimedia 4x, and Micron Electronics' P133 Millennia—were each based on Intel's Triton core-logic chip set. Each also employed synchronous L2 cache and used the Diamond Stealth 64 graphics accelerator.

Among Pentium/120 machines, SAG Electronics' STF 120, Tangent Computer's MediaStar 5120, and Zenon Technology's Dream Media P5-120 were tied for first place. The Tangent and Zenon systems combined the Quantum Fireball and Diamond Stealth 64 graphics accelerator for their top finish. The SAG unit used the same graphics card as the other two systems but combined it with Quantum's XP32150W SCSI-2 hard disk.

Machines with non-Intel chip sets generally turned in poorer results than those with Triton chip sets.

GRAPHICS WINMARK 95

The Number Nine Imagine 128, the Diamond Stealth 64, and Matrox Electronic Systems' Millennium provided the graphics power behind the top-finishing machines on our Graphics WinMark 95 tests. The Number Nine Imagine 128, an Editors' Choice in our graphics-card roundup of June 27, 1995 ("Ultrafast Graphics: The Professional's Choice"), gains its speed largely from its unique 128-bit data path between the graphics accelerator and the frame buffer.

The Diamond Stealth 64 uses S3's 64-bit Vision 968 chip.

In addition to powerful graphics acceleration—evidenced by the Graphics WinMark results—the Vision 968 chip supports integrated video scaling and acceleration.

The Matrox Millennium uses a new version of Matrox's MGA chip set as well as a unique memory system called Window RAM (WRAM). The new version of the MGA includes high-end capabilities such as 3-D acceleration, Gouraud shading, Z-buffering support, and video acceleration.

DISK WINMARK 95

In a surprise coup, SCSI-2 hard disks have stolen the performance throne from Enhanced IDE (E-IDE) and its variants. E-IDE had maintained its performance lead by supporting 32-bit disk access in Microsoft Windows. Now Adaptec, the leading SCSI supplier, has 32-bit disk drivers to boost hard disk performance under Windows, helping push the Disk WinMark 95 scores of the SAG STF 120 and STF 133 to the top of the heap. These PCs each paired a Quantum XP32150W SCSI-2 hard disk and an Adaptec AHA-2940W SCSI adapter card. The high rotational rate of the Quantum XP32150W hard disk—7,200 rpm, compared with 3,600 rpm for most hard disks—contributed to high performance by reducing rotational latencies.

Among non-SCSI-2 hard disks, the Quantum Fireball 1080A turned up in machines that scored phenomenally well on our tests: All 12 of the PCs containing Fireball drives took top finishes. This was primarily because of a 5,400-rpm rotational rate and a high data-transfer rate.

CPUMARK₁₆

Machines that earned the highest CPUmark₁₆ scores, indicating highly tuned processor-memory subsystems, employed both synchronous L2 cache and EDO DRAM. But the homogeneity of motherboards and chip sets is clear from the results of this test: Within each class, approximately the top half of machines had nearly identical scores.

ADDITIONAL TESTS

On our DOS tests, there is little to note except the low DOS Video performance of machines using the Number Nine Imagine 128 card and Compaq's MGA-based Matrox Athena card, which could result in poor performance on DOS games and applications.

On our CD-ROM tests, we found a pattern we've come to expect: Machines that loaded MSCDEX (Microsoft's CD-ROM extensions) before SmartDrive were able to cache CD-ROM data and turned in the best performance results.

How We Tested

All machines were tested with 16MB of RAM. We enabled SMARTDRV.EXE in write-back mode with a cache size of 4MB; on systems running Microsoft Windows for Workgroups, we set up a 32-bit file cache of 4MB and allowed Windows to shrink the SmartDrive cache to 128K. We standardized on a 20MB permanent swap file and defragmented the hard disk. We used each vendor's

preinstalled graphics driver for 800-by-600 resolution with 256 colors, small fonts, and a vertical refresh rate of 72 Hz. We also disabled power management features and removed any unnecessary drivers.

We used our benchmark test suite **Winstone 95**, Version 1.0, to measure the machines' performance when running typical Windows applications. Winstone 95 measures the time a PC takes to execute a set of scripts that exercise 13 of the best-selling Windows 3.1 applications. Winstone weights a given PC's test timings based on the applications' unit market shares; it derives a composite number and converts it to a relative score (relative to the performance of a 386DX/25 Compaq Deskpro/M with 4MB of RAM, whose score is defined as 10).

In tabular form, we also present separate Winstone scores for four categories of applications: **Spreadsheet, Word Processing, Database, and Business Graphics/Desktop Publishing**. Each of these scores is relative to the Compaq Deskpro/M, whose score is defined as 1.

We used WinBench 95, a suite of 102 tests of Windows GDI (Graphics Device Interface) functions, to measure the performance of each machine's graphics subsystem under Windows, generating the **Graphics WinMark 95** score, which we report in millions of pixels per second. These tests run in 13 graphics test mixes that WinBench weights and combines. We also used WinBench to determine the **Disk WinMark 95** score, a measure of disk subsystem performance under Windows. Both tests are based on extensive application profiling.

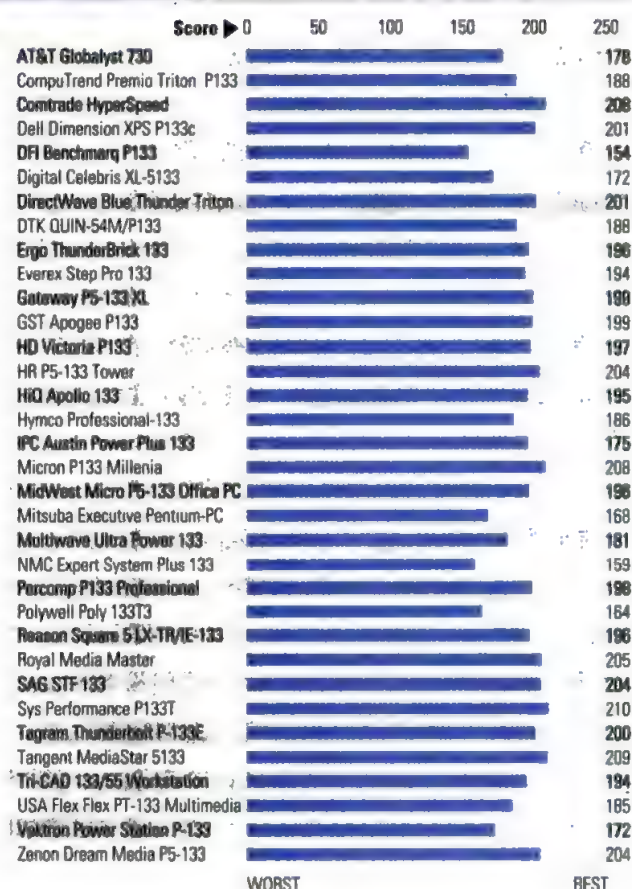
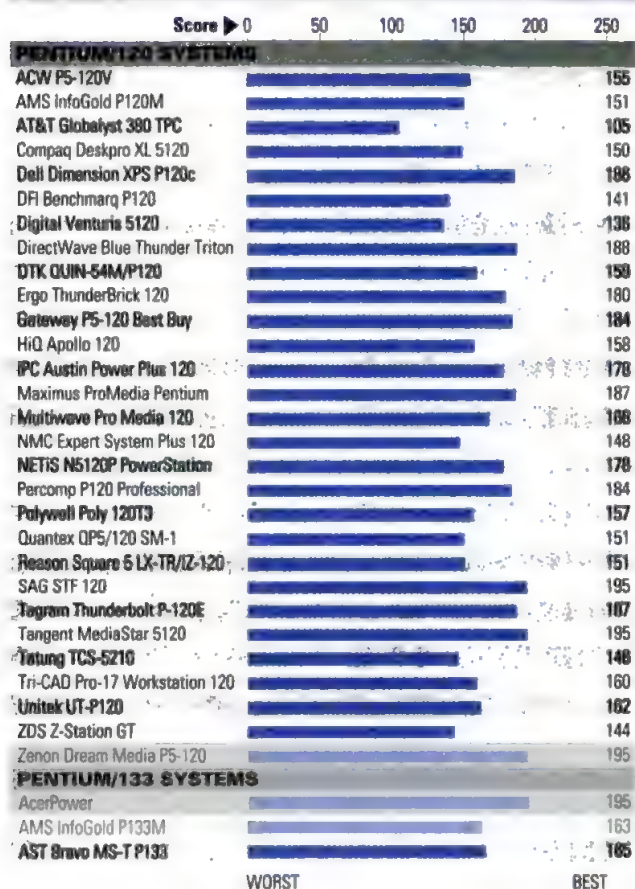
We used PC Bench 9.0 as a measure of processor, video, and disk perfor-

mance under DOS applications. The **CPUMark₁₆** score indicates the speed of a computer's processor subsystem, including the CPU, external processor cache, and system RAM. PC Bench bases this score on a large (400K) instruction mix and the floating-point coprocessor test. The **DOS Video** score indicates the speed of VGA read and write operations involving both text and graphics. The **DOS Disk** score reflects the performance of a computer's disk subsystem, which includes its hard disk, the hard disk controller and any hardware or software caches, under DOS. This disk test performs file reads, writes, creations, and deletion in a mix based on the disk usage of a set of profiled applications. The **DOSMark** score is a composite of the three separate results and approximates overall system performance under DOS.

Microsoft Corp. granted us permission to use VidTest—a tool for testing digital video performance—to gauge the quality of multimedia playback. We used VidTest to determine **CD-ROM Maximum Throughput**, a drive's best-case data-transfer rate, expressed in kilobytes per second. VidTest also let us measure **CD-ROM CPU Utilization**, the percentage of the processor's bandwidth occupied by servicing the CD-ROM subsystem at a 300-KBps transfer rate in 16K blocks (lower percentages represent better performance). We also used VidTest to determine the number of **Video Frames Dropped** during playback of an AVI file encoded at 160-by-120 resolution, 8-bit color, and 15 frames per second.

We generated **CD-ROM Database Search** results by timing each machine as it performed a complex full-text search of the Ziff-Davis CD-ROM Computer Select.

WINSTONE 95



I Want Power, Features And Reliability.

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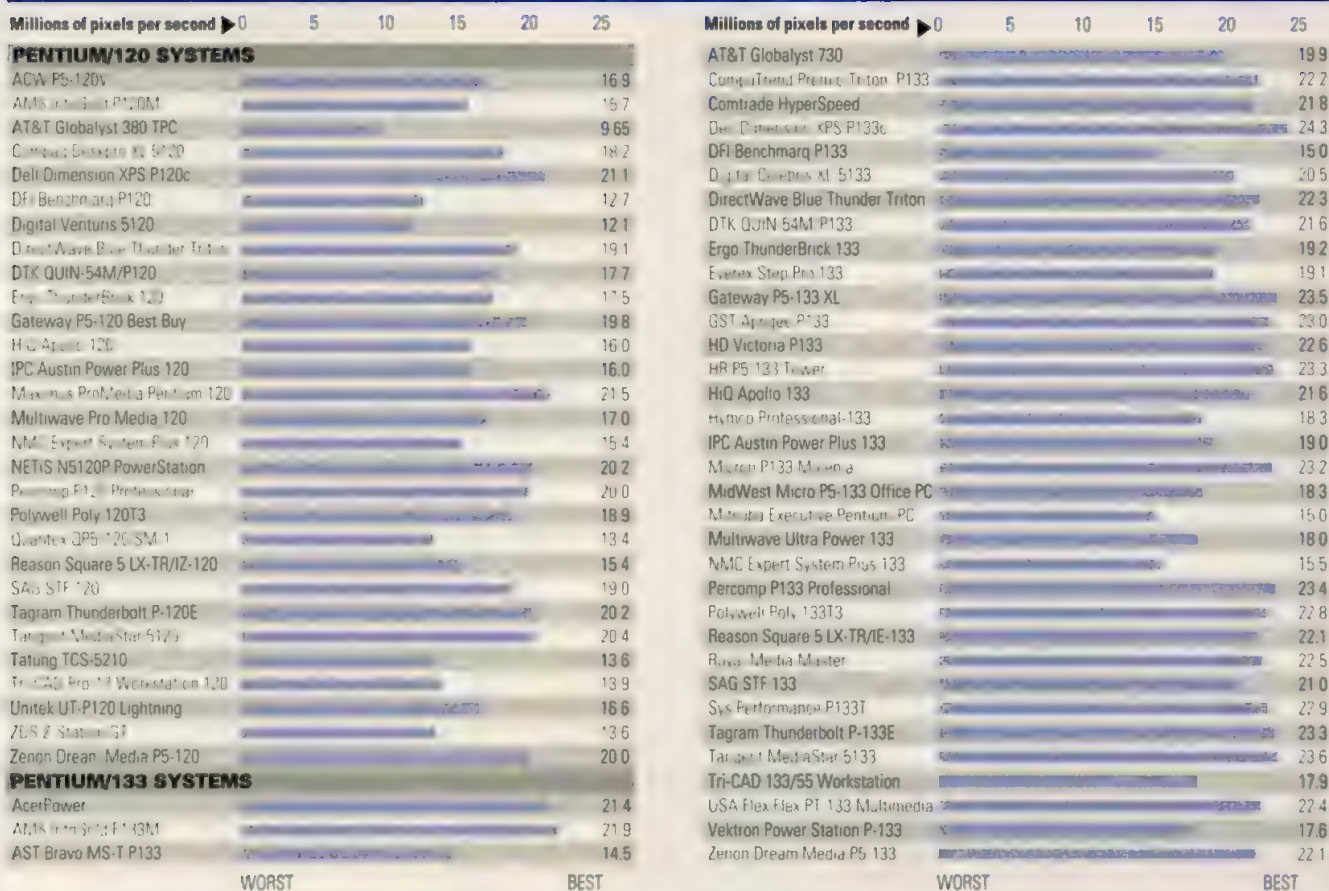
ZENITH
DATA SYSTEMS 

Make The Connection™



Benchmark Tests: 120- and 133-MHz Pentium PCs

GRAPHICS WINMARK 95



AT&T Global Information Solutions

Globalyst 380 TPC Globalyst 730

The AT&T Globalyst 730, with a street price of \$5,312, offers an appealing blend of innovative communications software, and average performance. Unfortunately, the AT&T Globalyst 380 TPC, which has a \$3,183 street price and also has some communications features, doesn't match that performance. AT&T targets high-end corporate users with the 730 and aims for the home-office market with the 380 TPC.

The Pentium/133-based 730 is a formidable communications tool. It features a variety of AT&T software that can do

things such as send text to a pager, forward e-mail headers to your pager, and send voice mail messages. A modem is required for these functions. The 730 also has integrated I/O, audio, and graphics.

The Pentium/120-based 380 TPC is housed in the same mini-tower case as the 730. It included a 19.2-/14.4-Kbps data/fax modem and software to provide full-duplex speakerphone and voice mail capabilities and Caller ID support.

IN SHORT

Great communications packages are offset by the 730's high price and the 380 TPC's poor performance.

SERVICE & RELIABILITY

AT&T GIS

Reliability	Worse than average
Repair	Average
Tech support	Average
% needing repair	Average

The 730 had mostly average scores across our Windows-based tests. Its Disk WinMark 95 score was below average, however. Its hard disk could not match the top performers in this roundup, and its VLSI chip set cannot support such

performance-boosting components as EDO DRAM.

The 380 TPC had below-average performance across the board. It lacked L2 cache (AT&T does not include L2 cache as part of the company's standard configurations), EDO DRAM, and Microsoft Windows for Workgroups, which has 32-bit file caching. The unit also used the budget-oriented S3 Trio 64 graphics chip set. These choices contributed to its poor performance.—Mary E. Behr

AT&T Global Information Solutions, Dayton, OH; 800-447-1124, 513-445-5000.

Circle 446 on reader service card

Compaq Computer Corp.

Deskpro XL 5120 Model 1050/MX

There are a few unique features integrated into Compaq's Deskpro XL 5120 Model 1050/MX, but they cannot make up for the unit's lackluster performance and comparatively high \$5,278



DISK WINMARK 95

Score ► 0 200 400 600 800 1,000 1,200 1,400

PENTIUM/120 SYSTEMS

ACW P5-120V	735
AMS InfoGold P120M	527
AT&T Globalyst 380 TPC	342
Compaq Deskpro XL 5120	446
Dell Dimension XPS P120c	1,010
DFI Benchmark P120	736
Digital Venturis 5120	602
DirectWave Blue Thunder Triton	934
DTK QUIN-54M/P120	722
Ergo ThunderBolt 120	810
Gateway P5-120 Best Buy	872
HQ Apollo 120	792
IPC Austin Power Plus 120	774
Maximus ProMedia Pentium 120	847
Multwave Pro Media 120	887
NMC Expert System Plus 120	771
NETIS NS120P PowerStation	859
Percomp P120 Professional	820
Polywell Poly 120T3	544
Quantex QP5-120 SM-1	784
Reason Square 5 LX-TR/IZ-120	671
SAG STF 120	1,220
Tagram Thunderbolt P-120E	985
Target MediaStar 5120	1,060
Tatung TCS-5210	794
Tri-CAD Pro 17 Workstation 120	856
Unitex UT-P120 Lightning	844
ZDS Z Station GT	711
Zenon Dream Media P5-120	1,060

PENTIUM/133 SYSTEMS

AcerPower	939
AMS InfoGold P133M	547
AST Bravo MS-T P133	787

WORST

BEST

Score ► 0 200 400 600 800 1,000 1,200 1,400

AT&T Globalyst 730

AT&T Globalyst 730	799
CompuTrend Premio Triton P133	834
Comtrade HyperSpeed	1,100
Der Benchmark XPS P133c	1,060
DFI Benchmark P133	787
Digital Venturis XL 5133	810
DirectWave Blue Thunder Triton	987
DTK QUIN-54M P133	834
Ergo ThunderBolt 133	937
Everex Step Pro 133	904
Gateway P5-133 XL	956
GST Apogee P133	1,050
HD Victoria P133	968
HR P5-133 Tower	1,070
HiQ Apollo 133	895
Hymio Professional 133	1,110
IPC Austin Power Plus 133	944
Micron P133 Multimedia	1,010
MidWest Micro P5-133 Office PC	952
Mitsuba Executive Pentium PC	1,020
Multwave Ultra Power 133	928
NMC Expert System Plus 133	790
Percomp P133 Professional	836
Polywell Poly 133T3	551
Reason Square 5 LX-TR/IE-133	896
Royal Media Master	990
SAG STF 133	1,260
Sys Performance P133T	1,100
Tagram Thunderbolt P-133E	1,020
Target MediaStar 5133	1,090
Tri-CAD 133/55 Workstation	939
USA Flex Flex PT 133 Multimedia	994
Vektron Power Station P-133	936
Zenon Dream Media P5-133	1,040

WORST

BEST

street price (though it does include a 17-inch monitor). Compaq markets this high-end business PC to users of advanced applications, such as CAD and engineering software. Compaq also sells the PCI/ISA-based Deskpro line of midrange business PCs and the ProLinea line of entry-level business PCs. Compaq targets its Presario line at the home market (none of these lines are reviewed here).

The Deskpro XL's PCI/EISA motherboard has

IN SHORT

This high-priced business PC offers an above-average design but has some performance trade-offs.

SERVICE & RELIABILITY

Compaq Computer Corp.

Reliability	Better than average
Repair	Better than average
Tech support	Better than average
% needing repair	Better than average

a built-in PCI Ethernet controller and SCSI support. It also has Enhanced Business Audio, which provides voice-recognition and annotation functions, and includes the Vocalyst keyboard, which integrates a speaker as well as ports for a microphone and headphones. The unit originally came with a quad-speed CD-ROM drive. This device had driver conflicts with our tests and Compaq sent a double-speed drive as a replacement.

Using a Matrox IS-Athena R1-based graphics card, the unit posted an average Graphics WinMark 95 score and a barely average Winstone 95 score. Unfortunately, the system was running under Microsoft Windows 3.1, which does not support 32-bit file access, and used a 1GB SCSI disk drive, which does not support Windows' 32-bit disk access. These factors helped make its Disk WinMark 95 score one of the lowest in this roundup.—WPF

Compaq Computer Corp., Houston, TX; 800-345-1518; fax, 713-378-1442.

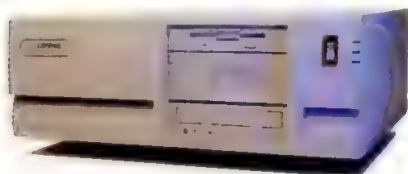
Circle 447 on reader service card

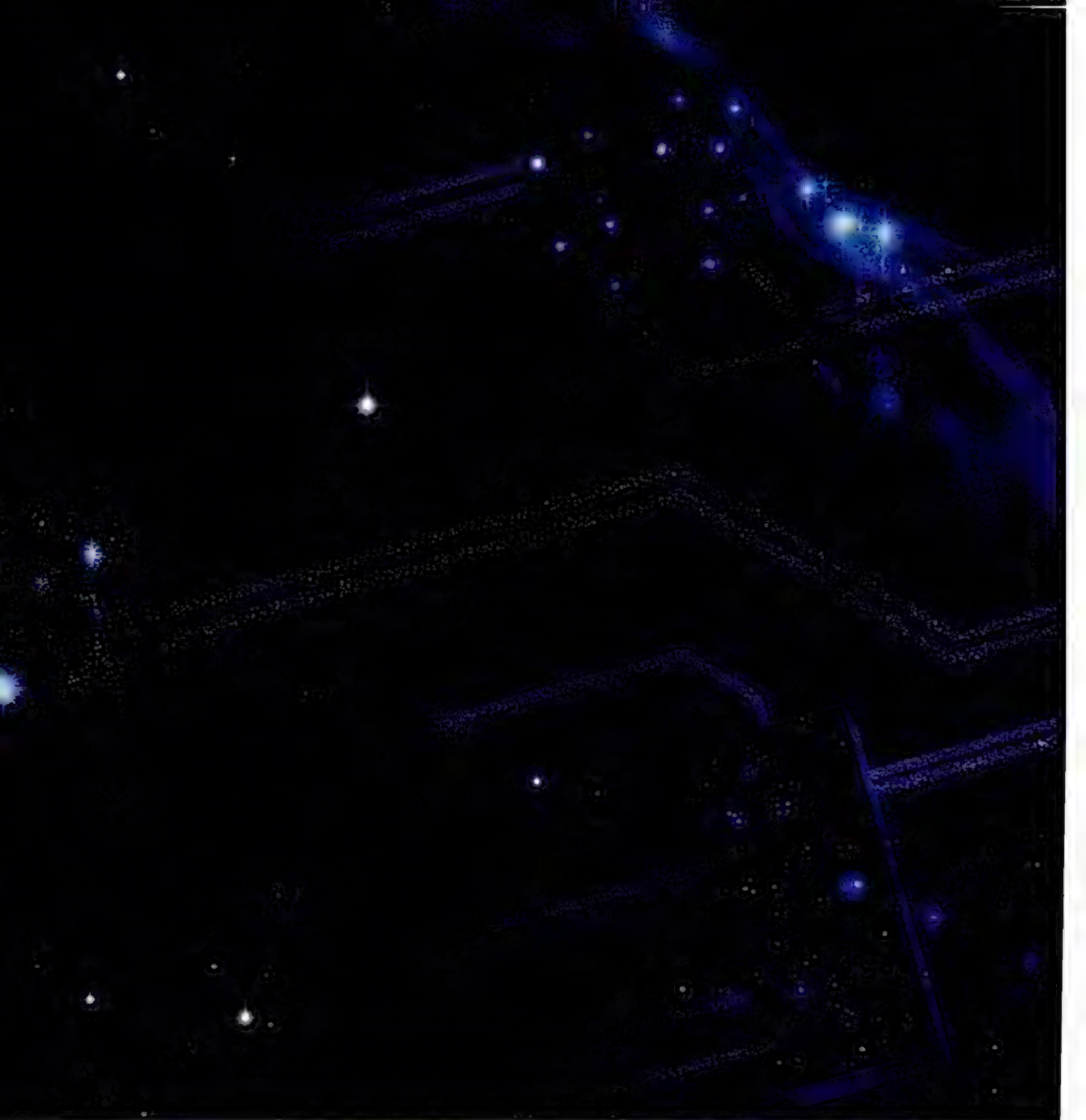
CompuTrend Systems Inc.

Premio Triton P133

The \$3,299 133-MHz Pentium-based Premio Triton P133 from CompuTrend Systems is an average system with quality components and an attractive price. CompuTrend targets this desktop system toward the small-office and home-office markets.

The unit's ISA/PCI-based motherboard uses a Triton chip set and came with 256K of synchronous pipelined-burst external processor cache and EDO DRAM. A 1GB Seagate hard disk, a quad-speed CD-ROM drive, a 16-bit Acer Magic S30 sound card, and a 15-inch monitor are also included with the system. Its



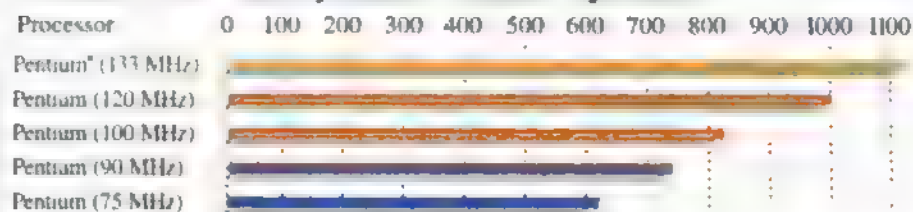


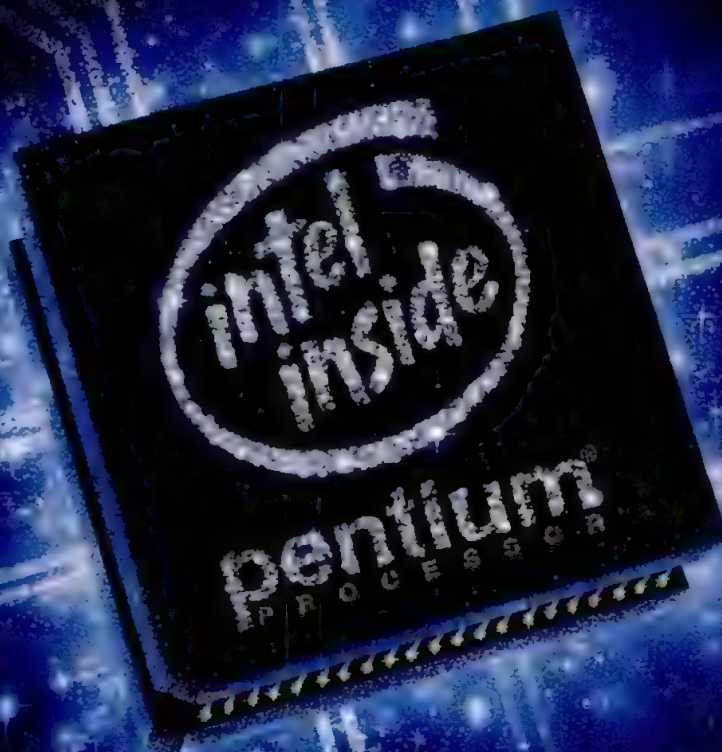
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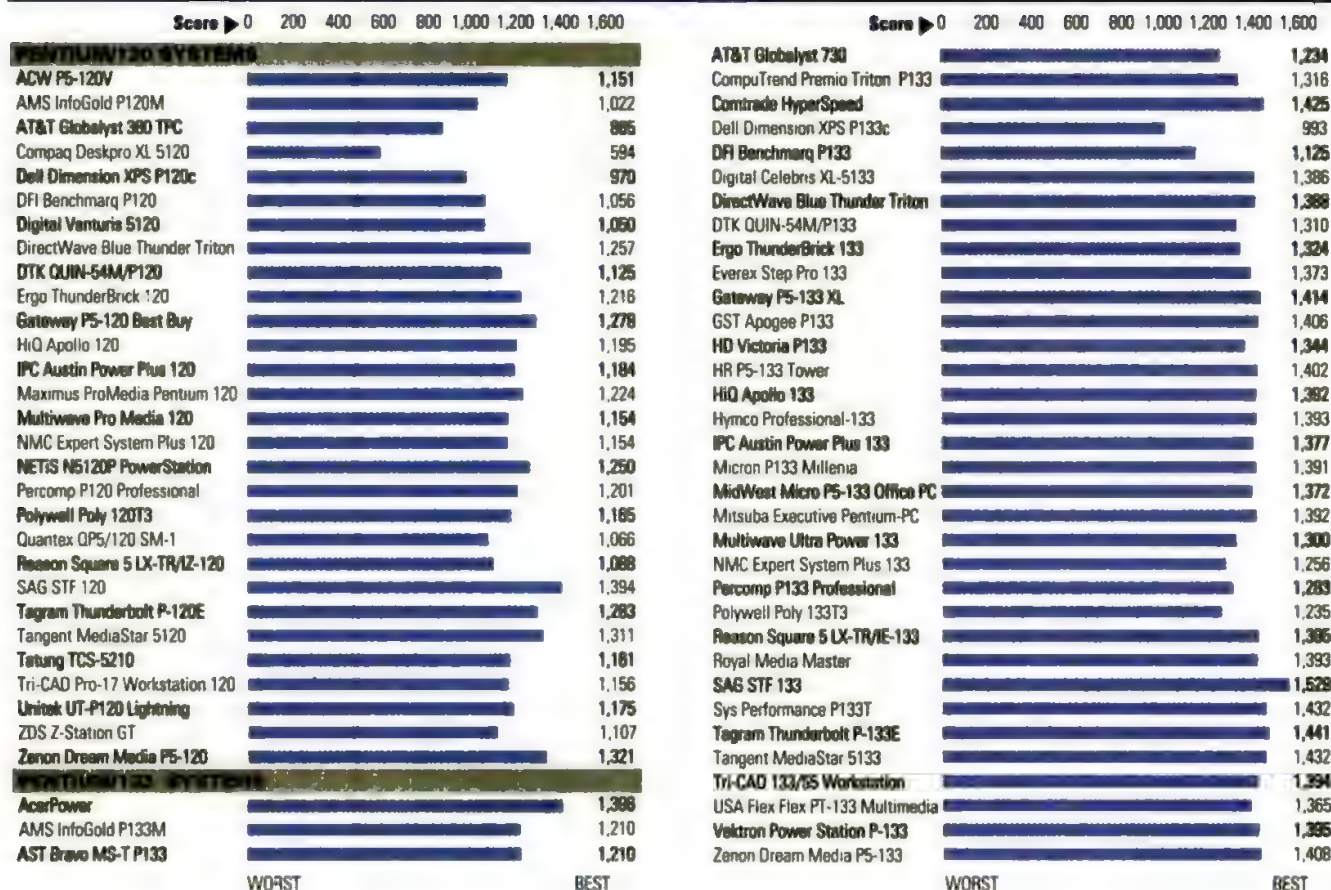
even more challenging software already on the way, you'll want to be sure to get the most powerful Pentium processor available. So for stellar PC performance, on your next PC purchase, ask for an Intel Pentium processor. Reach Intel on the Internet at <http://www.intel.com/procs/pentium/> for more information.

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intel®
The Computer Inside.

Benchmark Tests: 120- and 133-MHz Pentium PCs

DOSMARK



graphics subsystem was based on the Number Nine Motion771 graphics accelerator with 2MB of VRAM, which is based on S3's speedy Vision968 chip set.

The Premio did well on our benchmark tests for the most part. Its Winstone 95 and Graphics WinMark 95 scores were average. Its Disk WinMark 95 score was slightly below average for its processor class, however. Its Seagate hard disk could not keep up with those of the performance leaders in this roundup.

The system's software bundle is good but may be better geared toward the family-PC market. It includes the Microsoft Home bundle—composed of titles such as Microsoft Encarta, Microsoft Money, and Microsoft Works—and a variety/entertainment pack.

CompuTrend offers a two-year parts-and-labor warranty with the Premio. Four years of on-site service are available from

GE for a total of \$299.—**WPF CompuTrend Systems Inc., City of Industry, CA; 800-677-6477, 818-333-5121; fax, 818-369-6803.**

Circle 448 on reader service card

Comtrade HyperSpeed MPEG Multimedia 4X

If the speedy performance of the Comtrade HyperSpeed MPEG Multimedia 4X is not enough to attract the attention of buyers, then its enticing \$3,195 price tag will be. This mini-tower system is targeted toward small- and home-office buyers, and its hardware should fit this market well.

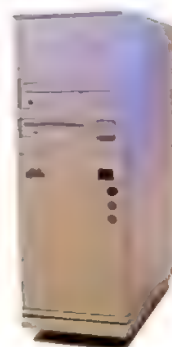
The machine we tested features an ISA/PCI-based motherboard using the Triton chip set and 256K of synchronous external processor cache. The system also features the same

1GB Quantum Fireball hard disk installed in some of the best-performing systems in this roundup. The unit had a graphics subsystem based on the Diamond Stealth 64 graphics accelerator with 2MB of VRAM, which uses the S3 Vision968 chip set; this card was also found in most of the performance leaders in this roundup.

The system garnered benchmark test scores that were among the best in this roundup. Its Quantum Fireball hard disk pulled its Disk WinMark 95 score to above average for its class, and no doubt

contributed to a Winstone 95 score just shy of the above-average range. The HyperSpeed's Graphics WinMark 95 score was also good.

The unit's software bundle included Microsoft Encarta and Microsoft Works. The system also features a



IN SHORT

Above-average performance and an affordable price make this system easy to recommend.

GPUMARK_{1G}

Score ► 0 50 100 150 200 250 300

PENTIUM/120 SYSTEMS

ACW P5-120v	235
AMS ProMedia P120M	255
AT&T Globalyst 380 TPC	174
Compaq Deskpro XL 5120	253
Dell Dimension XPS P120c	257
DFI Benchmark P120	237
Digital Ventures 5120	232
DirectWave Blue Thunder Triton	256
DTK QUIN-54M/P120	238
Ergo ThunderBrick 120	257
Gateway P5-120 Best Buy	257
HD Apollo 120	236
IPC Austin Power Plus 120	257
Maxima ProMedia Pentium 120	257
Multiwave Pro Media 120	236
NMC Expert System Plus 120	234
NETIS N5120P PowerStation	253
Percomp P120 Professional	254
Polywell Poly 120T3	258
Quantex QP5-120-SM1	235
Reason Square 5 LX-TR/120	234
SAG STF 120	255
Tagram Thunderbolt P-120E	258
Tangent MediaStar 5120	258
Tatung TCS-5210	243
Tr-CAD Pro 17 Workstation 120	235
Unitek UT-120 Lightning	235
ZDS Z-System 120	234
Zenon Dream Media P5-120	256

PENTIUM/133 SYSTEMS

AcerPower	287
AMS ProMedia P133M	282
AST Bravo MS-T P133	263

WORST

BEST

Score ► 0 50 100 150 200 250 300

AT&T Globalyst 730	281
Comp.Trend Premium Triton P133	284
Comtrade HyperSpeed	285
Dell Dimension XPS P133c	288
DFI Benchmark P133	260
Digital Ventures XL 5133	278
DirectWave Blue Thunder Triton	286
DTK QUIN-54M/P133	282
Ergo ThunderBrick 133	285
Everex Step Pro 133	285
Gateway P5-133 XL	285
GST Apogee P133	288
HD Victoria P133	284
HR P5-133 Tower	285
HiQ Apollo 133	286
Hymco Professional 133	281
IPC Austin Power Plus 133	285
Multimedia P133 Multimedia	286
MidWest Micro P5-133 Office PC	285
Mitsuba Executive Pentium PC	260
Multiwave Ultra Power 133	264
NMC Expert System Plus 133	260
Percomp P133 Professional	285
Polywell Poly 133T3	287
Reason Square 5 LX-TR/IE-133	285
Rova Media Master	287
SAG STF 133	281
Sys Performance P133T	289
Tagram Thunderbolt P-133E	287
Tangent MediaStar 5133	289
Tr-CAD 133/55 Workstation	285
USA Flex Flex PT-133 Multimedia	284
Vektron Power Station P-133	285
Zenon Dream Media P5-133	285

WORST

BEST

16-bit Orchid SoundWave 32 sound card, 115-watt speakers, a 15-inch monitor, and a Mitsumi quad-speed CD-ROM drive.

Comtrade includes a one-year parts-and-labor warranty with the HyperSpeed. On-site service costs \$50 for the first year.—WPF

Comtrade, City of Industry, CA; 800-969-2123, 818-961-6688; fax, 818-330-1829.

Circle 449 on reader service card

Dell Computer Corp.

Dimension XPS P120c Dimension XPS P133c

If you need a powerful yet affordable PC, you won't go wrong with Dell Computer Corp.'s Pentium/120-based Dimension XPS P120c, with a street price of \$3,649, or its Pentium/133-based sibling, the Dimension XPS P133c, with a street price of \$3,899. Both of these mini-tower PCs posted top-notch scores on most of our tests.

The Dimension XPS is the high-performance end of Dell's Dimension line, which is targeted at home and small-business users. Dell also markets the OptiPlex line, which emphasizes reliability and has longer product cycles, to corporate users.



Both systems used EDO DRAM and came with 1GB Quantum Fireball hard disks, 17-inch monitors, quad-speed CD-ROM drives, and Number Nine Imagine 128 PCI graphics cards with 4MB of VRAM. To provide audio, the two systems had Creative Labs Vibra 16 sound cards and pairs of Altec Lansing multimedia speakers with large subwoofers. The XPS P133c also came with a 28.8-Kbps fax modem.

Both systems proved to be excellent performers. The XPS P120c had above-average scores on all of our Windows-based tests, outperforming a good number of Pentium/133 units. The XPS P133c was nearly as good; its only average score came on our Winstone 95 tests. The two did especially well on our Graphics WinMark 95 tests, where the XPS P133c had the highest score of all the reviewed units.

IN SHORT

Buoyed by terrific disk performance, the Dell Dimensions are excellent choices.

SERVICE & RELIABILITY Dell Computer Corp.

Reliability	Better than average
Repair	Better than average
Tech support	Better than average
% needing repair	Average

Dell offers a two-year-parts, one-year-labor warranty. On-site service is included for the first year.—**Robert S. Anthony Dell Computer Corp., Austin, TX; 800-613-3355, 512-338-4400; fax, 800-727-8320.**

Circle 450 on reader service card



Benchmark Tests: 120- and 133-MHz Pentium PCs

CONTINUES

DOS

WINSTONE 95

CD-ROM

▲ Higher scores represent better performance

▼ Lower scores represent better performance.

	Video ▲	Disk ▲	Spread- sheet ▲	Word Processing ▲	Database ▲	Business Graphics/ DTP ▼	Maximum Throughput (KBps) ▲	CPU Utilization (percent) ▼	Video Frames Dropped ▼	Database Search (min:sec) ▼
ACW P5-120V	5,059	784	15.8	14.4	15.0	17.5	602	26	0	2:14
AMS InfoGold P120M	3,129	681	15.1	13.7	15.4	17.3	597	51	8	2:50
AT&T Globalyst 300 TPC	4,120	584	10.3	10.0	9.9	12.7	601	48	0	2:15
Compaq Deskpro XL 5120 1050/MX	653	855	14.6	14.3	14.6	17.0	300	27	0	3:03
Dell Dimension XPS P120c	1,672	954	18.6	16.8	19.0	21.1	600	30	0	2:32
DFI Benchmark P120	3,742	718	14.1	12.4	14.4	16.8	601	29	0	2:38
Digital Venturis 5120	4,234	689	13.7	11.9	13.7	16.4	601	36	0	2:14
DirectWave Blue Thunder PT5P120B	5,153	879	18.7	17.1	18.7	22.1	601	22	0	4:56
DTK QUIN-54M/P120	5,052	738	16.4	14.6	15.2	18.1	600	23	0	1:52
Ergo ThunderBrick 120	4,586	850	18.1	16.1	18.3	21.2	602	39	0	2:12
Gateway P5-120 Best Buy	5,604	884	18.4	16.7	18.7	21.3	599	48	0	2:34
HiQ Apollo 120	5,064	852	16.2	14.5	15.0	18.6	602	32	0	3:27
IPC Austin Power Plus 120	4,586	799	18.1	15.9	18.4	20.1	604	38	0	1:56
Maximus Promedia Pentium 120	5,155	826	18.7	17.0	18.8	21.7	602	28	0	2:27
Multiwave Pro Media 120	5,057	787	17.3	15.5	15.6	19.6	667	27	0	1:59
NMC Expert System Plus 120	5,252	780	15.1	13.0	14.9	18.0	486	66	0	2:23
NETIS N5120P PowerStation	5,154	879	17.9	16.2	17.6	20.7	602	39	0	1:58
Percomp P120 Professional	5,153	799	18.5	16.6	18.5	21.3	600	29	0	2:31
Polywell Poly 120T3	5,152	740	15.9	14.6	15.6	17.4	601	38	0	1:55
Quantex QP5/120 SM-1	4,310	699	15.5	13.8	14.9	16.9	601	40	0	2:00
Reason Square 5 LX-TR/12-120	5,039	698	15.5	13.9	14.6	17.0	600	32	0	3:19
SAG STF 120	5,138	1,143	19.5	17.4	19.4	23.3	600	10	0	1:46
Telegram Thunderbolt P-120E	5,151	917	18.6	16.9	18.2	22.8	601	39	1	1:58
Tangent MediaStar 5120	5,153	966	19.5	17.5	19.8	22.7	600	58	0	2:13
Tatung TCS-5210	5,816	743	14.8	13.6	13.8	17.6	495	62	14	2:40
Tri-CAD Pro-17 Workstation 120	4,563	821	16.3	14.5	15.8	18.4	901	11	0	2:47
Unitex UT-P120 Lightning	5,062	821	16.5	14.9	15.8	18.5	602	31	0	3:26
ZDS Z-Station GT	5,203	716	14.7	12.7	14.5	17.0	602	39	0	2:01
Zenon Dream Media P5-120	5,154	989	19.6	17.6	20.0	22.5	600	25	0	0:56

DFI

Benchmark P120 Benchmark P133

Though the Pentium/120-based Benchmark P120, with a street price of \$3,895, and the Pentium/133-based Benchmark P133, with a street price of \$4,295, are reasonably priced, their performance was decidedly lacking. DFI targets these two tower units at expansion-minded home and business buyers.

The company gets users off to a good start by providing 14.4-Kbps fax modems and Microsoft's Home bundle. The units also included 1.2GB hard disks, Mozart-16 audio cards and 17-inch monitors.

On our Windows-based tests, however, both units posted



scores that were well below average for their respective CPU groups. The Benchmark P133's Winstone 95 score was the lowest of the Pentium/133 systems tested—even lower than that of most of the reviewed Pentium/120 PCs.

In many ways, the DFI units were victims of older technology. Both used standard DRAM and VLSI chip sets, which did not perform well overall compared with units tested with EDO DRAM and Triton chip sets. Since the VLSI chip set cannot support write-back L2 cache, these units had slower, buffered write-through L2 cache. This combination lowered the units' CPUmark₁₆ scores, which in turn affected their other scores. Also, while most of the graphics cards seen here used VRAM, the Benchmarks' DFI cards came with DRAM and were based on the budget-oriented S3 Trio 64 chip set.

IN SHORT
A generous software bundle is a plus, but the Benchmarks' poor performance is a minus.

DFI backs these units with two-year-parts,

lifetime-labor warranties.—RSA

DFI, Sacramento, CA; 800-808-4334, 916-568-1234; fax, 916-568-1233.

Circle 451 on reader service card

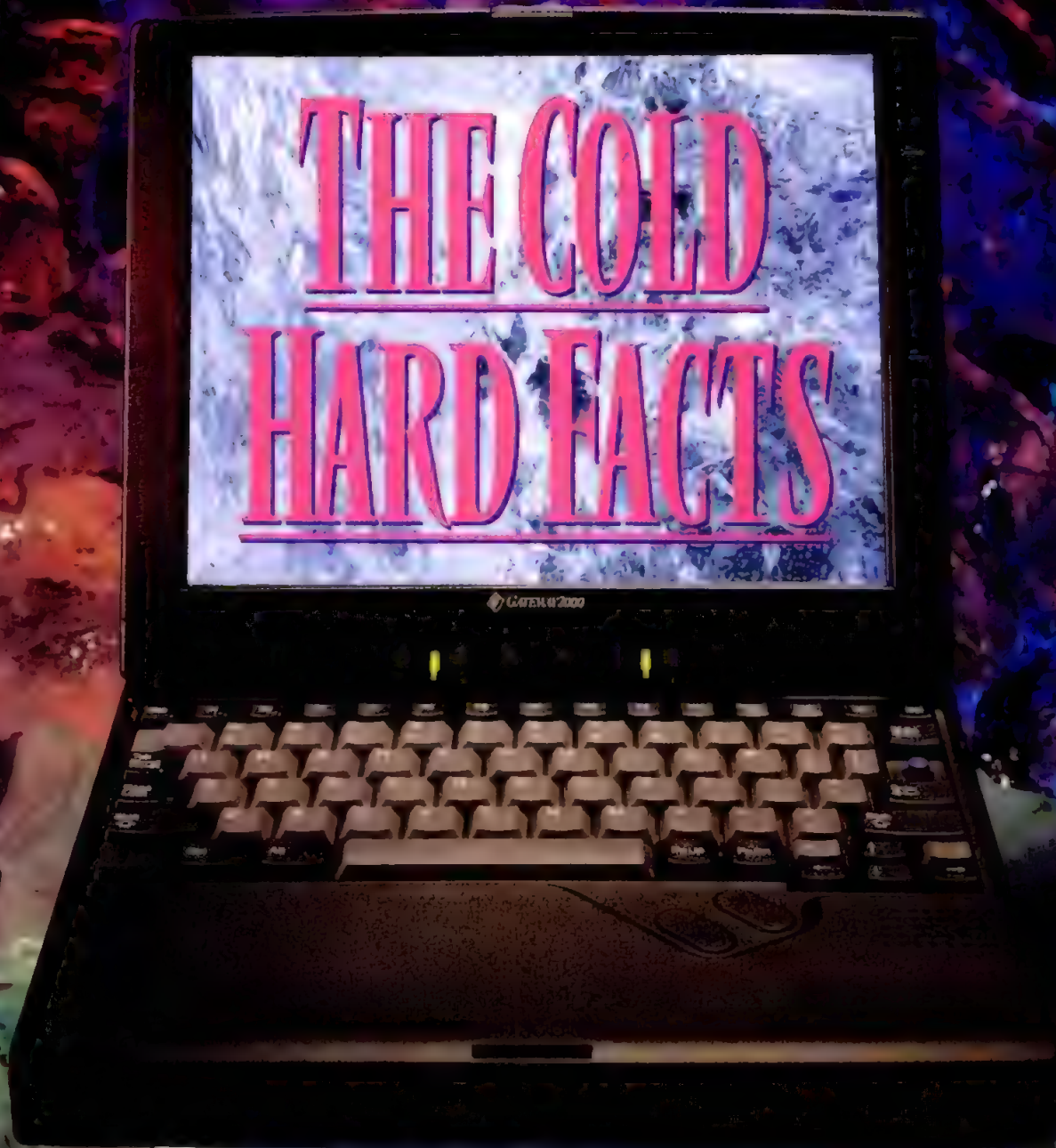
Digital Equipment Corp.

Venturis 5120 Celebris XL 5133

Digital Equipment Corp.'s \$4,626 Venturis 5120 and \$5,468 Celebris XL 5133 are standouts in terms of design, but neither unit was a performance leader.

The Pentium/120-based Venturis desktop is aimed at entry-level business users, while the Pentium/133-based Celebris tower unit is meant for higher-end business users. Digital also offers the Starion retail brand for small- and home-office users. Both units we tested earn points for serviceable design touches, such as easy-open cases and swing-away drive bays.

The Venturis's motherboard was based on a SIS chip set, whereas the Celebris used a Neptune-based motherboard. Digital



GATEWAY2000
LIBERTY



CLEAR-CUT ANSWERS

Your choice of a portable PC may not seem like a crystal clear decision at first. There are about a gazillion portables to choose from. Want some clear-cut answers to what's right for you?

Gateway 2000® offers quality portables with performance and features that'll thrill you to chills. But whether or not a Gateway Liberty™ or ColorBook™ portable PC is the right choice for you, look at these guidelines before choosing your portable PC.

Processor

You'll need a 486DX2 processor at the very minimum. Every Gateway 2000 portable PC includes a DX4 processor. A 486DX4 has the power to make your spreadsheets, graphics and word processing all run better and faster.

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Cache is great — that is when you can find it on a portable — because it gives you a superior performance. Our Liberty DX4-100 includes 256K L2 cache on an accelerated local bus yielding Pentium®-like performance. The ColorBook² includes 512K video cache for great video performance.

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Nothing less than a removable 340MB hard drive will do. In fact, you'll want the largest hard drive you can get. Microsoft® Windows®, DOS® and standard software applications automatically consume around 140MB at the time of purchase. And the Microsoft Windows 95 operating system takes about 160MB. All Liberty and ColorBook² PCs include at least a 340MB removable hard drive that can be upgraded to a whopping 720MB.

RAM (Random Access Memory)

A bare *minimum* of 8MB RAM is best — 4MB wasn't enough last year. To adequately run Windows and Windows 95 you'll need 8MB. 8MB will also increase your battery life and improve system performance. All Liberty and ColorBook² systems come standard with at least 8MB RAM and are expandable to 16MB or 24MB RAM.

Screen

When you're talking portables, you want the biggest, clearest display possible without adding weight or hiking up the price.

The 10.4-inch Liberty screen has an incomparable screen size-to-weight ratio of 2.44 giving you 23 percent more active viewing area than a 9.4-inch screen and 53 percent more than an 8.4-inch screen.

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Size and Weight

It's a portable PC — the smaller and the less it weighs, the better! The Liberty and ColorBook² are leaders in these areas.

Batteries

Look for between four and five hours of battery life depending on the processor and RAM. Batteries based on lithium ion will give you the best performance. The Liberty gives you up to five hours or more with power management and a lithium ion battery.

Software

Included top-selling software applications increase the value of your portable PC. Gateway pre-installs Microsoft Works for Windows 3.0 or MS Office Professional 4.3 on all Gateway portables, as well as OAG® FlightDisk® and World Clock software.

Keyboard & Pointing Device

You'll need a keyboard that's comfortable for you and that's also easy to use. The Liberty is equipped with a large palm rest, and flip-out feet so you can adjust the keyboard angle.

Pointing devices vary greatly. Again, find one that's easy for you to work with. Gateway's EZ Point™ integrated pointer is uniquely positioned to be comfortable and easily accessible.

Infrared Technology (IR)

Extras such as the Liberty's IR technology add even more value to your portable PC. With it you can take advantage of wireless file transfer — this means transferring files between the Liberty and your desktop (or between two Liberty PCs) without cables!

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Make sure you have the right support for your portable PC. Gateway 2000 has well-trained, dedicated portables and Windows 95 technical support technicians on call, 24 hours a day, seven days a week, for the life of your Gateway system. We also offer a special VIP warranty.

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Benchmark Tests: 120- and 133-MHz Pentium PCs

ENDS

DOS

WINSTONE 95

CD-ROM

▲ Higher scores represent better performance.
▼ Lower scores represent better performance.

	Video ▲	Disk ▲	Spread- sheet ▲	Word Processing ▲	Database ▲	Business Graphics/ DTP ▲	Maximum Throughput (KBps) ▲	CPU Utilization (percent) ▼	Video Frames Dropped ▼	Database Search (min:sec) ▼
AcerPower	5,425	989	19.6	17.4	20.2	22.4	670	25	0	1:50
AMS InfoGold P133M	5,356	739	16.3	14.4	16.6	19.2	599	36	0	1:54
AST Bravo MS-T P133	3,898	882	16.7	14.9	16.7	18.5	300	55	0	5:45
AT&T Globalyst 730	4,446	874	18.0	16.2	17.3	20.8	600	23	0	3:29
CompuTrend Premio Triton P133	5,303	880	18.5	16.8	19.5	22.1	600	29	0	2:28
Comtrade HyperSpeed Multimedia 4X	5,358	1,050	20.9	18.6	21.0	24.6	602	22	0	2:03
Dell Dimension XPS P133c	1,517	1,050	20.0	18.0	20.7	23.2	601	29	0	2:24
DFI Benchmark P133	3,766	765	15.5	13.4	15.6	18.7	600	28	0	2:28
Digital Celebris XL5133	7,206	911	17.3	16.2	16.8	19.2	512	37	0	1:56
DirectWave Blue Thunder PT5P133B	5,361	984	20.1	18.1	20.0	24.0	578	29	0	2:21
DTK QUIN-54M/P133	5,337	876	18.9	17.0	18.7	22.0	601	30	0	3:25
Ergo ThunderBrick 133	4,989	910	19.8	17.1	19.8	23.5	602	34	0	1:51
Everex Step Pro 133	4,984	989	19.5	17.3	20.2	22.3	601	31	0	2:31
Gateway P5-133 X	5,957	989	19.9	17.9	20.2	22.9	602	39	0	2:05
GST Apogee P133	5,359	1,007	19.7	17.5	20.5	24.4	601	14	0	2:57
HD Victoria P133	5,355	918	19.8	17.6	20.1	23.0	600	36	0	1:55
HR P5-133 Tower	5,358	1,010	20.4	18.3	20.7	24.0	833	35	0	1:37
HiQ Apollo 133	5,361	988	19.6	17.5	19.5	23.1	602	31	0	3:13
Hymco Professional-133	4,982	1,043	18.7	16.7	19.1	21.4	601	30	0	3:25
IPC Austin Power Plus 133	5,085	989	19.9	17.2	20.5	22.0	901	15	0	1:29
Micron P133 Millenia	5,356	989	21.1	18.8	21.2	24.0	901	19	0	1:30
MidWest Micro P5-133 Office PC	4,983	989	20.0	17.4	20.6	22.2	602	28	0	2:11
Mitsuba Executive Pentium-PC	4,887	1,141	16.9	15.2	16.5	20.1	601	30	0	3:23
Multiwave Ultra Power 133	5,319	915	18.3	16.5	17.6	21.4	669	26	0	1:57
NMC Expert System Plus 133	5,710	836	16.1	13.9	15.9	19.4	543	62	0	2:23
Percomp P133 Professional	5,359	827	19.9	17.7	20.0	23.3	901	14	0	1:30
Polywell Poly 133T3	5,358	760	16.6	15.0	16.7	18.2	601	36	0	1:55
Reason Square 5 LX-TR/IE-133	5,490	989	19.6	17.6	20.1	22.8	831	56	0	2:29
Royal Media Master	5,365	989	20.7	18.2	20.8	23.9	899	15	0	1:30
SAG STF 133	5,322	1,288	20.1	18.0	20.6	25.1	600	11	0	1:46
Sys Performance P133T	5,358	1,047	21.0	18.7	21.3	25.4	660	14	0	2:48
Tagram Thunderbolt P-133E	6,256	1,008	19.9	18.2	20.2	23.0	901	13	0	2:37
Tangent MediaStar 5133	5,358	1,047	20.9	18.5	21.3	24.9	589	55	0	2:22
Tri-CAD 133/55 Workstation	5,452	989	19.3	17.2	20.3	22.7	901	16	0	1:34
USA Flex Flex PT-133 Multimedia	5,355	953	18.8	16.9	18.4	21.0	602	37	0	1:56
Vektron Power Station P-133	5,564	984	17.3	14.9	17.8	21.0	603	30	0	3:23
Zenon Dream Media P5-133	5,505	1,010	20.4	18.1	20.6	24.0	600	22	0	0:54

opted for the latter in the Celebris because the unit's CPU sits on a proprietary card with room for an additional CPU—and the newer Triton chip set does not support multiprocessing. This CPU card can also be swapped for one with a Digital Alpha RISC CPU, though you will need Microsoft Windows NT to run it.

The Venturis logged below-average scores on all of our Windows-based tests, including a very low Graphics WinMark 95 score. This unit had integrated graphics

based on S3's budget-oriented Trio 64 chip set and 1MB of DRAM, which slowed it.

The Celebris fared better. Using a Matrox Millennium graphics card with 2MB of WRAM (Window RAM), the unit

posted average Winstone 95 and Graphics WinMark scores but a below-average Disk WinMark 95 score.—RSA

Digital Equipment Corp., Maynard, MA; 800-642-4532, 508-624-6400; fax, 800-652-4532.

Circle 452 on reader service card

DirectWave Inc.

Blue Thunder Triton PT5P120B Blue Thunder Triton PT5P133B

The \$2,849 Blue Thunder Triton PT5P120B and the \$2,999 Blue Thunder Triton PT5P133B, from DirectWave, offer an attractive combination: competitive prices and admirable performance on our benchmark tests.

DirectWave, founded in 1993, is a subsidiary of TVM Corp., a monitor manufacturer. The company initially specialized in multimedia upgrades but now offers the Blue Thunder line of mainstream multimedia PCs for home and



IN SHORT

The Digital units are well designed, but they come up short on performance.

SERVICE & RELIABILITY Digital Equipment Corp.

Reliability	Better than average
Repair	Better than average
Tech support	Better than average
% needing repair	Better than average

120- and 133-MHz Pentium PCs



IN SHORT

Each DirectWave system offers solid performance for its price class.

motherboards. The PT5P133B's motherboard offered integrated I/O ports, one of which was used to connect a 1.23GB Conner hard disk. The PT5P120B came with a 1GB IBM hard disk but its motherboard offered no I/O integration; DirectWave said integrated I/O will be offered by the time you read this.

Within its CPU class, the PT5P120B was an average or above-average performer on all Windows-based tests, logging an especially good Disk WinMark 95 score. The PT5P133B was an average performer on all Windows-based tests within the unit's group.

DirectWave offers a one-year parts-and-labor warranty. On-site service is \$45 for one year.—RSA

DirectWave Inc., Ontario, CA; 800-882-8108, 909-390-8098; fax, 909-390-8061.

Circle 453 on reader service card

DTK Computer Inc.

QUIN-54M/P120 QUIN-54M/P133

The \$3,350 120-MHz Pentium QUIN-54M/P120 and the \$3,650 133-MHz Pentium QUIN-54M/P133 from DTK Computer are reasonable choices, offering respectable performance at competitive prices. DTK sells mainly to resellers that, in turn, custom-configure each machine for government buyers. The company also sells directly to government or corporate customers.

The midtower case used in both systems can be opened without tools and offers considerable expansion room. Both machines were similarly configured with a

business users.

Both midtower units came with Sound Blaster 16 sound cards and Diamond Stealth Video graphics accelerators with 2MB of VRAM. Strangely, the PT5P120B came with EDO DRAM, but the faster PT5P133B used standard DRAM. The two

also had different

16-bit Creative Labs Vibra 16 sound card, a speedy S3 Vision968-based Diamond Stealth graphics accelerator with 2MB of VRAM, a quad-speed CD-ROM drive, and a 1GB Fast ATA-2 hard disk. Both machines also used asynchronous external processor cache, 512K on the QUIN-54M/P120 and 256K on the QUIN-54M/P133.

The two DTK systems proved to be mostly average performers within their CPU classes on across all of our Windows-based tests. The only exception was a below-average Disk WinMark 95 score logged by the QUIN-54M/P133. Its Seagate hard disk could not keep up with those of the competition in its 133-MHz Pentium processor class.

DTK offers a two-year parts-and-labor warranty with each of these systems. On-site service is an additional \$50 for the first year.—RSA

DTK Computer Inc., City of Industry, CA; 800-289-2385, 818-810-0098; fax, 808-810-0090.

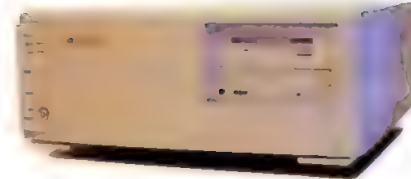
Circle 454 on reader service card

Ergo Computing Inc.

ThunderBrick 120 ThunderBrick 133

The Pentium/133-based ThunderBrick 133, with a list price of \$3,895, and the Pentium/120-based ThunderBrick 120, with a list price of \$3,595, both offer average performance, an exceptional warranty, and competitive prices—and both are solid choices for demanding users. Ergo Computing aims these desktop PCs at power-hungry home and small-business users.

Both ThunderBricks use EDO DRAM and 256K of synchronous pipelined-burst



IN SHORT

Ergo's ThunderBricks offer enough good features to merit serious consideration.

external processor cache. The systems' Intel motherboards feature on-board Creative Labs Vibra 16S

16-bit audio chip sets. Both units also came with ATI Graphics Pro Turbo graphics cards with 4MB of VRAM.

Heavy graphics users will appreciate the monitor bundled with the ThunderBricks: a 17-inch Nokia 447L with built-in, bottom-mounted stereo speakers. The ThunderBrick 133 had a 1.2GB hard disk and the ThunderBrick 120 came with a 1GB hard disk.

Performance was average across the board for both machines on all Windows-based tests. Both systems also came with a handful of Windows applications, including askSam (information management software), ClarisWorks, Icon Hear-It (an audio-software package), and OAG FlightDisk (travel software).

Ergo Computing offers a remarkable four-year warranty that not only includes parts and labor but also covers on-site service for the duration.—RSA

Ergo Computing Inc., Peabody, MA; 800-633-1922, 508-535-7510; fax, 508-535-7512.

Circle 455 on reader service card

Everex Systems Inc.

Step Pro 133

The Step Pro 133, with a street price of \$3,795, is Everex's top-of-the-line single-processor system for business users. This unit was a solidly average performer on our benchmark tests, and some of its components—including its TVM 17-inch monitor and 1.5GB hard disk—were impressive.

Everex also sells the Step DP line of



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120- and 133-MHz Pentium PCs

dual-processor systems, the Step SP value line of 75- to 120-MHz Pentium machines, and the midrange Step SP2 line of 75- to 120-MHz Pentium computers (none reviewed here).

The Pentium/133-based Step Pro's tower case is well organized, and its internal components are accessible. The unit's ISA/PCI-based Intel motherboard has 256K of synchronous external processor cache and provides integrated 16-bit audio, which supports FM synthesis. A quad-speed Mitsumi CD-ROM drive is also included with the system.

The Step Pro was a competitive performer. The system produced average scores on all of our Windows-based benchmark tests.

As do all of Everex's machines, the Step Pro 133 comes with a three-year

parts-and-labor warranty, with on-site service included for the first year.—*Cade Metz*

Everex Systems Inc., Fremont, CA; 800 - 821-0806, 510 - 498-1111; fax, 510-683-2186.

Circle 456 on reader service card

IN SHORT

The Step Pro sports a fine design, average performance, and extras like a 17-inch monitor.

SERVICE & RELIABILITY
Everex Systems Inc.

Reliability	Average
Repair	Average
Tech support	Worse than average
% needing repair	Average

Gateway 2000 Inc.

P5-120 Best Buy
P5-133 XL

Gateway 2000 targets business users with its \$3,999 P5-133 XL and \$3,079 P5-120 Best Buy, both from the company's Professional line. Both pack some good extras, such as 28.8-Kbps fax modems, Altec Lansing speakers, and Microsoft Office. While the P5-133 delivered average performance, the P5-120 took its cue from its Editors' Choice-winning predecessor (the Gateway P5-120 in our roundup of May 30, 1995) and garnered above-average scores across our Windows-based tests. Gateway also markets a Family PC line (not reviewed), featuring a more consumer-oriented software bundle.

The P5-133 tower system came with 1.5GB hard disk, a three-CD changer (\$100 upgrade, included in the above

price), a 17-inch monitor, and Altec Lansing ACS31 speakers with subwoofer (\$110 option with the Ensoniq sound card, included in the above price). The P5-120 desktop featured a 1GB hard disk, a 15-inch monitor, and two ACS5 speakers (\$99 option with Sound Blaster wavetable sound card, included in the above price).

The P5-133 turned in middle-of-the-road Winstone 95 and Disk WinMark 95 scores. On our Graphics WinMark 95 tests, however, its Matrox Millennium graphics card with 2MB of WRAM (new Window RAM) managed to produce a well-above-average score. The P5-120 (which also used the Matrox Millennium card) posted above-average scores on all of our Windows-based tests.

The systems have a three-year-parts and one-year-labor warranty, plus one year of on-site service. Gateway has also just started offering 24-hour, 7-day telephone technical support.—*CM*

Gateway 2000 Inc., North Sioux City, SD; 800-846-2000, 605-232-2000; fax, 605-232-2023.

Circle 457 on reader service card

GST/Micro City

Apogee P133

Marketed mostly toward midsize and large businesses, the \$3,469 Apogee P133 from GST/Micro City is relatively affordable compared with other units in this roundup, and its performance was consistently among the best we tested.

GST also sells a separate line (not reviewed) specifically for the small-office/home-office market. This line is based on



IN SHORT

Each of these terrific performers has nice extras like a fax modem and quality speakers.

SERVICE & RELIABILITY

Gateway 2000 Inc.

Reliability	Better than average
Repair	Better than average
Tech support	Better than average
% needing repair	Average

the Intel DX4/100 processor.

As tested, the 133-MHz Pentium Apogee P133 had a ISA/PCI-based motherboard with the Triton chip set, EDO DRAM, and 512K of synchronous external processor cache (most others in this roundup used 256K of secondary cache). The unit also featured a 1GB Quantum Fireball hard disk. This hard disk was found in most of the best disk performers in this roundup. The unit also featured the top-performing Diamond Stealth 64 graphics accelerator with 2MB of VRAM, which is based on an S3 Vision968 chip set, a 15-inch monitor, and a quad-speed CD-ROM drive.

Because of its well-chosen components, the system posted some of the highest scores overall on our Disk WinMark 95 and Graphics WinMark 95 tests. Its Winstone 95 score was average for its 133-MHz Pentium class.

The system is backed by a one-year part-and-labor warranty. You may purchase an on-site service contract—with a three-year minimum—for an additional \$94.—*WPF*

GST/Micro City, Cerritos, CA; 800-579-2764, 714-739-0106; fax, 714-739-8291.

Circle 458 on reader service card

HD Systems Inc.

Victoria P133

The Victoria P133, with a street price of \$3,699, offers average performance at a reasonable price, although it is not the most remarkable system in this roundup. HD Systems aims this 133-MHz Pentium machine at the corporate market.



IN SHORT

A solid corporate workstation, the Apogee P133 offers affordable, high-end performance.

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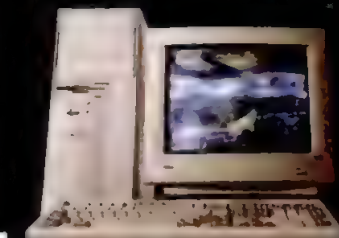
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SUMMARY OF FEATURES

Pentium 120s and 133s

This desktop system was configured with a Triton-based SuperMicro motherboard, a 1GB ATA-2 hard disk, and a Diamond Stealth 64 graphics accelerator with 2MB of VRAM, which uses S3's speedy new Vision968 chip set. In addition to a quality software bundle that includes Microsoft Bookshelf and Microsoft Office, HD added the ergonomic Microsoft keyboard. The company also included a pair of 160-watt speakers to go with the Creative Labs Sound Blaster 16 sound

IN SHORT

The Victoria P133 is a better-than-average system for the corporate market.

card and a Toshiba quad-speed CD-ROM drive. The inclusion of a 15-inch MAG monitor saves you \$300 (the upgrade price to a 17-inch monitor) but may disappoint some people expecting a total high-end package.

Equipped with 256K of synchronous pipelined-burst external processor cache, the Victoria P133 fared well on our benchmark tests. The unit posted average scores for its processor class on our Winstone 95 and Disk WinMark 95 tests. It fared especially well on our Graphics WinMark 95 tests, where its score was nearly above-average.

HD Systems offers a one-year parts-and-labor warranty with the Victoria P133. One year of on-site service is an additional \$50.—WPF

HD Systems Inc., Sunnyvale, CA; 800-864-3843, 408-720-0493; fax, 408-720-1967.

Circle 459 on reader service card

Hewlett Rand Corp.

HR P5-133 Tower

Hewlett Rand Corp. aims the \$3,599 HR P5-133 Tower at the business world, positioning it as a graphic-design workstation. The quality of the components and the above-average performance of this 133-MHz Pentium machine indicate that it can handle just about any corporate job.

If you are thinking of using this unit as a graphics workstation, you may want to upgrade the MAG 15-inch monitor we received to a 17-inch one (\$399 to upgrade). However, the system's other components, such as the sextuple-speed Plextor CD-ROM drive, the Creative Labs Sound Blaster 16 sound card, the Diamond

Price For machines sold through resellers, assume street prices will be 15 to 20 percent lower than list prices. Some companies factor this discount into their quoted prices; in such cases, we indicate that the cited price is a street price.

Installed RAM Some machines use EDO (extended data out) DRAM, which can marginally boost performance over standard fast-page mode DRAM.

Hard disk interface E-IDE denotes Enhanced IDE, an extension to IDE that supports faster transfer rates, higher disk capacities, and mass-storage devices other than hard disks. Fast ATA-2 denotes Seagate's E-IDE-like specification for increased transfer rates and larger capacities.

Graphics adapter (and memory) VRAM and the new WRAM (Windows RAM) graphics memory types are faster than DRAM because both can move data in and out simultaneously.

CD-ROM drive interface ATAPI is a specification

Stealth 64 graphics accelerator with the S3 Vision968 chip set, and the Quantum Fireball 1GB hard disk (which was found in most of this issue's best performers) are all dead on target and should serve you well. The unit rounds out its list of quality components with EDO DRAM and 256K of synchronous pipelined-burst L2 cache on the motherboard.

The HR P5-133's hardware comes through on our benchmark tests. The HR P5-133 posted a Winstone 95 score that was among the best overall. Additionally, the system posted Disk WinMark 95 and Graphics WinMark 95 scores that were well above the average for this group.

Hewlett Rand offers two years of coverage for parts and labor on the system, and seven years on the moth-

that enables CD-ROM drives to act much like hard disks, which allows them to be connected to Enhanced IDE interfaces. Drives with *proprietary* interfaces connect to a special connector on a sound board.

DOS, Windows version included DOS implies MS-DOS, unless otherwise specified. WFWG denotes Windows for Workgroups, and Win indicates Windows.

Flash BIOS replaces conventional ROM storage and can be electronically reprogrammed, making the BIOS upgradable simply by downloading new software.

A Plug and Play BIOS can map out motherboard resources to ease upgrades when used with a Plug and Play-compliant operating system (such as Windows 95 or forthcoming versions of OS/2).

Expansion-bus slots PCI cards may share a backplane with ISA cards, meaning that you can use one or the other but not both simultaneously. Such shared slots are listed as PCI/ISA.

erboard. On-site service for two years is available for an additional \$60.—WPF
Hewlett Rand Corp., Redmond, WA; 800-869-7074, 206-869-5555; fax, 206-869-5151.

Circle 460 on reader service card

HiQ Computer Systems

Apollo 120 Apollo 133

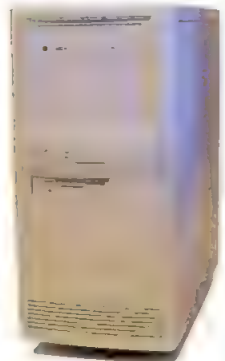
Power users will like HiQ's two Apollo systems, and so will bookkeepers. The Pentium/120-based Apollo 120 has a street price of only \$2,688, and the 133-MHz version is an exceptional value at a street price of \$2,988. These prices do not reflect cut corners, either: Both of these systems were mostly average performers within their respective processor groups.

Processor aside, the systems were nearly identical, using the same ISA/PCI-based motherboard with a Triton chip set.



IN SHORT

Above-average performance, components, and warranty make this PC easy to recommend.



SUMMARY OF FEATURES

120- and 133-MHz Pentium PCs

■ YES ■ NO

Products listed in review order

	AcerPower	ACW P5-120V	AMS InfoGold P120M	AMS InfoGold P133M	AST Bravo MS-T P133	AT&T Globalyst 300 TPC	AT&T Globalyst 730	Compaq Deskpro XL 5120 Model 1050/MX
Price (tested configuration)	\$3,995 (street)	\$2,964 (list)	\$2,995 (street)	\$3,695 (street)	\$3,350 (street)	\$3,183 (street)	\$5,368 (street)	\$5,278 (street)
Processor	Pentium/133	Pentium/120	Pentium/120	Pentium/133	Pentium/133	Pentium/120	Pentium/133	Pentium/120
Installed RAM	16MB EDO	16MB EDO	16MB	16MB	16MB	16MB	16MB	16MB
Hard disk capacity and interface	1.5GB E-IDE	1GB Fast ATA-2	1.2GB E-IDE	1.2GB E-IDE	1.5GB E-IDE	1GB E-IDE	1GB E-IDE	1GB SCSI-2
Graphics adapter (and memory)	Diamond Stealth 64 Video VRAM (2MB VRAM)	Diamond Stealth 64 Video VRAM (2MB VRAM)	Alliance ProMotion 6410 (2MB DRAM)	Diamond Stealth 64 Video VRAM (2MB VRAM)	Integrated ATI Mach 64 (2MB DRAM)	Integrated S3 Trio 64 (1MB VRAM)	Integrated S3 Vision968 (2MB VRAM)	Compaq QVision 2000 (2MB VRAM)
Monitor (and diagonal screen size)	Acer AcerView 7076i (17")	Proton GM-1563 (15")	Proton PM-1561 (14")	Sony CPD-17SF1 (17")	AST Vision 5L (14")	AT&T Cam63 0z (15")	AT&T TX-D1751L (17")	Compaq QVision 172 (17")
CD-ROM drive (and speed and interface)	Acer 645A (4x ATAPI)	Mitsumi CRMC-FX400 (4x ATAPI)	TEAC CD-55A (4x proprietary)	Toshiba XM-5302B (4x ATAPI)	Sony CDU33A-01 (2x ATAPI)	Toshiba XM-5302B (4x ATAPI)	Sony CDU76E (4x ATAPI)	Matsushita CR-503B (2x SCSI)
Sound adapter	Acer Magic	Sound Technology ST2260	Creative Labs Sound Blaster 16	Creative Labs Sound Blaster 16	Creative Labs Vibra 16S	AT&T Media Magic	ESS Technologies ES688F	Compaq
Speakers/Network adapter/Modem included	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
DOS, Windows version included	6.22, WWVG 3.11	6.22, WWVG 3.11	6.22, WWVG 3.11	6.22, WWVG 3.11	6.22, WWVG 3.11	6.22, Win 3.1	6.22, WWVG 3.11	6.2, Win 3.1
Motherboard Components								
Installed external RAM cache and type	256K synchronous	256K asynchronous	256K synchronous	256K synchronous	256K asynchronous	None	256K synchronous	256K synchronous
Motherboard manufacturer	Acer	ASUSTek	ASUSTek	TMC	AST Computer	AT&T	AT&T	Compaq
Chip set manufacturer and model	Intel Triton	Intel Triton	Intel Triton	Intel Triton	SIS 85C50x	VLSI VL82C59x	VLSI VL82C59x	Compaq
BIOS manufacturer and version (or date)	Acer (5/24/95)	Award (4/20/95)	Award (4/20/95)	Award (4/20/95)	IBM (6/05/95)	Phoenix (5/30/95)	Phoenix (5/10/95)	Compaq (3/27/95)
Flash BIOS/Plug and Play BIOS	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Multiprocessor socket	■	■	■	■	■	■	■	■
Expandability								
Maximum RAM	128MB	128MB	128MB	128MB	128MB	192MB	192MB	144MB
Expansion-bus slots	4 ISA, 4 PCI, 1 PCI/ISA	3 ISA, 4 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 4 PCI, 1 PCI/ISA	5 ISA, 2 PCI, 1 PCI/ISA	5 ISA, 3 PCI, 1 PCI/ISA	6 ISA, 2 PCI, 1 PCI/ISA	3 EISA, 1 PCI, 1 PCI/EISA
Accessible drive bays (5.25", 3.5")	3, 2	3, 1	3, 2	4, 0	3, 1	3, 1	3, 1	3, 0
Internal drive bays (5.25", 3.5")	0, 2	0, 1	0, 2	0, 3	0, 4	0, 1	0, 1	0, 1
Power-supply wattage	200W	230W	230W	250W	200W	250W	250W	240W
Parallel, serial, mouse ports	1, 1, 1	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 1	1, 2, 1	1, 1, 1	1, 2, 1
EPP/ECP parallel interfaces supported	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Service and Support								
7-day, 24-hour live technical support	■	■	■	■	■	■	■	■
Standard warranty on parts/labor	3 years/1 year	1 year/1 year	1 year/1 year	1 year/1 year	3 years/3 years	3 years/3 years	3 years/3 years	3 years/3 years
On-site service charge (and term)	Included (1 year)	\$109.95 (1 year)	\$75 (1 year)	\$75 (1 year)	Included (3 years)	Included (1 year)	Included (1 year)	Included (1 year)

One difference: While the Apollo 133 also had EDO DRAM, the 120-MHz version we received did not (though it is now standard).

IN SHORT

These average performers carry attractive sub-\$3,000 price tags.

Both machines also performed well on our tests. The Apollo 120's scores were on a par with those of other 120-MHz systems on all of our Windows-based benchmark tests. The Apollo 133 also did fairly well, with average Winstone 95 and Graphics WinMark 95 scores; its Disk WinMark 95 score was below average, however.

Both machines also performed well on our tests. The Apollo 120's scores were on a par with those of other 120-MHz systems on all of our Windows-based benchmark tests. The Apollo 133 also did fairly well, with average Winstone 95 and Graphics WinMark 95 scores; its Disk WinMark 95 score was below average, however.

HiQ complements the affordability of these machines with a one-year warranty on parts and two-year coverage on labor. Two years of on-site service can be purchased for an additional \$79.95; three years of on-site service cost \$97.95.—WPF
HiQ Computer Systems, Sunnyvale, CA; 800-827-5836, 408-245-5836; fax, 408-245-3108.

Circle 461 on reader service card

Hymco Technologies Inc.

Professional-133

Hymco Technologies has been in business for 13 years, quietly selling PCs direct for the last 10 years. Much like the company, the \$3,195 Professional-133 is a system that does the job well without

much fanfare. Using some quality components and a good design, it performed fairly well on our benchmark tests. Hymco targets the system to the high-end corporate and desktop markets.

The system had particularly good disk performance: Its Disk WinMark 95 score was well above the average of the 133-MHz Pentium group, due mainly to the strength of the 1GB Quantum Fireball Fast ATA-



IN SHORT

Hymco's affordable system offers average performance.

PCs
120- and 133-MHz Pentium PCs

Continues

CompuTrend Premio Triton P133	Comtrade HyperSpeed MPEG Multimedia 4x	Dell Dimension XPS P120c	Dell Dimension XPS P133c	DFI Benchmark P120	DFI Benchmark P133	Digital Venturis 5120	Digital Celebris XL 5133	DirectWave Blue Thunder Triton PTSP120B	DirectWave Blue Thunder Triton PTSP133B
\$3,299 (street)	\$3,195 (list)	\$3,649 (street)	\$3,899 (street)	\$3,895 (street)	\$4,295 (street)	\$4,626 (list)	\$5,468 (list)	\$2,849 (list)	\$2,999 (list)
Pentium/133	Pentium/133	Pentium/120	Pentium/133	Pentium/120	Pentium/133	Pentium/120	Pentium/133	Pentium/120	Pentium/133
16MB EDO	16MB	16MB EDO	16MB EDO	16MB	16MB	16MB	16MB	16MB EDO	16MB
1GB Fast ATA-2	1GB Fast ATA-2	1GB Fast ATA-2	1GB Fast ATA-2	1.2GB E-IDE	1.2GB E-IDE	1.2GB E-IDE	1GB SCSI-2	1GB ATA-2	1.2GB E-IDE
Number Nine Motion771 (2MB VRAM)	Diamond Stealth 64 Video VRAM (2MB VRAM)	Number Nine Imagine 128 (4MB VRAM)	Number Nine Imagine 128 (4MB VRAM)	DFI WG- 3120P (2MB DRAM)	DFI WG- 3120P (2MB DRAM)	Integrated S3 Trio 64 (1MB VRAM)	Matrox Millennium (2MB VRAM)	Diamond Stealth 64 Video VRAM (2MB VRAM)	Diamond Stealth 64 VRAM (2MB VRAM)
Scepter F562DU (15")	KFC CA1507 (15")	Dell D1728-LS (17")	Dell D1728-LS (17")	ADI MicroScan 5EP (17")	ADI MicroScan 5EP (17")	Digital PCXBV- PC (17")	Digital PCXBV- PC (17")	Aurora Vision SM583 (15")	Aurora Vision SM583 (15")
Mitsumi CRMC- FX400 (4x ATAPI)	Mitsumi CRMC- FX400 (4x ATAPI)	Mitsumi CRMC- FX400 (4x ATAPI)	Mitsumi CRMC- FX400 (4x ATAPI)	Mitsumi CRMC- FX400 (4x ATAPI)	Mitsumi CRMC- FX400 (4x ATAPI)	Mitsumi CRMC- FX400 (4x ATAPI)	Toshiba XM- 5201B (4x SCSI-2)	Mitsumi CRMC- FX400 (4x ATAPI)	Mitsumi CRMC- FX400 (4x ATAPI)
Acer Magic S30	Orchid Sound Wave 32	Creative Labs CT2260	Creative Labs Vibra 16	DFI Mozart-16	DFI Mozart-16	Ensoniq Soundscape	Ensoniq Soundscape	Creative Labs Sound Blaster 16	Creative Labs Sound Blaster 16
6.22, WTWG 3.11	6.22, WTWG 3.11	6.2, WTWG 3.11	6.2, WTWG 3.11	6.22, WTWG 3.11	6.22, WTWG 3.11	6.22, WTWG 3.11	6.22, WTWG 3.11	6.22, WTWG 3.11	6.22, WTWG 3.11
256K synchronous	256K synchronous	256K synchronous	256K asynchronous	256K asynchronous	256K asynchronous	256K asynchronous	256K synchronous	256K synchronous	256K synchronous
CompuTrend Intel Triton	Tyan Intel Triton	Dell Intel Triton	Dell Intel Triton	DFI VLSI VL82C59x	DFI VLSI VL82C59x	Digital SIS 85C50x	Digital Intel Neptune	Super Micro Intel Triton	Asustek Intel Triton
Award (5/11/95)	Award (4/29/95)	AMI (5/12/95)	AMI (5/12/95)	Award (3/20/95)	Award (4/20/95)	Phoenix (4/21/95)	Phoenix (6/05/95)	AMI (10/10/94)	Award (5/08/95)
128MB	128MB	128MB	128MB	256MB	256MB	128MB	192MB	128MB	128MB
4 ISA, 4 PCI, 1 PCI/ISA	4 ISA, 4 PCI	3 ISA, 3 PCI, 1 PCI/ISA	4 ISA, 4 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	4 ISA, 2 PCI, 1 PCI/ISA	4 ISA, 3 PCI, 1 PCI/ISA	4 ISA, 4 PCI, 1 PCI/ISA	4 ISA, 4 PCI, 1 PCI/ISA
3.2	3.2	3.1	3.1	4.1	4.1	2.2	3.1	3.2	3.2
0.1	0.3	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.2
200W	210W	230W	230W	250W	250W	200W	300W	200W	200W
1, 2, 1	1, 2, 0	1, 2, 1	1, 2, 1	1, 2, 0	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 0	1, 2, 0
2 years/2 years	1 year/1 year	2 year/1 year	2 years/1 year	2 years/Lifetime	2 years/Lifetime	3 years/3 years	3 years/3 years	1 year/1 year	1 year/1 year
\$299 (4 years)	\$50 (1 year)	Included (1 year)	Included (1 year)	\$58 (1 year)	\$58 (1 year)	Included (1 year)	Included (1 year)	\$45 (1 year)	\$45 (1 year)

2 hard disk. This disk performance helped the unit achieve an average Winstone 95 score. Its ATI Winturbo-based graphics subsystem, with 2MB of VRAM, could not keep up with those of other units in this roundup, however, and pulled the system's Graphics WinMark 95 score to below average.

Some of the more notable components included with the system were a pair of midrange Altec Lansing speakers, a Toshiba quad-speed CD-ROM drive, and a Nokia 15-inch monitor (an upgrade to a 17-inch monitor costs \$239), as well as an ergonomic Microsoft keyboard.

Hymco includes a two-year warranty on parts and labor with the Professional-133 but currently does not offer any on-site service.—WPF

Hymco Technologies Inc., San Jose, CA; 800-884-9626, 408-251-6888; fax, 408-251-2333.

Circle 462 on reader service card

IPC Technologies Inc.

Austin Power Plus 120 Austin Power Plus 133

Austin's systems offer an attractive combination of performance, software, and components, such as 28.8/14.4-Kbps data/fax modems and 17-inch Nokia monitors with integrated speakers. The \$4,999 Austin Power Plus 133 also offers a sextuple-speed CD-ROM drive and a 1.5GB hard disk, while the \$3,999 Austin Power Plus 120 features a quad-speed CD-ROM drive and a 1.2GB hard disk. Austin

targets small-office and corporate audiences with these systems. The company also markets the PowerPlay line of single- and dual-CPU PowerPC machines and the Premiere PCI line of entry-level 486-based systems (neither line reviewed here).

Both mini-tower units performed competitively.



The Power Plus 133 and Power Plus 120 posted solidly average scores across all of our Windows-based benchmark tests.

Included with these systems are Microsoft Office, NetCruiser (an

SUMMARY OF FEATURES

120- and 133-MHz Pentium PCs

	DTK QUIN-54M/P120	DTK QUIN-54M/P133	Ergo Thunder-Brick 120	Ergo Thunder-Brick 133	Everex Step Pro 133	Gateway PS-120 Best Buy	Gateway PS-133 XL	GST Apollo P133
Price (tested configuration)	\$3,400 (list)	\$3,700 (list)	\$3,595 (list)	\$3,895 (list)	\$3,795 (list)	\$3,079 (list)	\$3,999 (list)	\$3,489 (list)
Processor	Pentium/120	Pentium/133	Pentium/120	Pentium/133	Pentium/133	Pentium/120	Pentium/133	Pentium/133
Installed RAM	16MB	16MB	16MB EDO	16MB EDO	16MB EDO	16MB EDO	16MB EDO	16MB EDO
Hard disk capacity and interface	168 Fast ATA-2	168 Fast ATA-2	168 Fast ATA-2	1.2GB E-IDE	1.5GB E-IDE	1GB E-IDE	1.5GB E-IDE	168 Fast ATA-2
Graphics adapter (and memory)	Diamond Stealth 64 Video VRAM (2MB VRAM)	Diamond Stealth 64 Video VRAM (2MB VRAM)	ATI Graphics Pro Turbo (4MB VRAM)	ATI Graphics Pro Turbo (4MB VRAM)	ATI Winturbex (2MB VRAM)	Matrox Millennium (2MB VRAM)	Matrox Millennium (2MB VRAM)	Diamond Stealth 64 Video VRAM (2MB VRAM)
Monitor (and diagonal screen size)	DTK CM15VBR (15")	DTK CM15VBE (15")	Nokia 447L (17")	Nokia 447L (17")	TVM AS8G (17")	Gateway CPD-15F13 (15")	Gateway Vivitron 1776 (17")	Aurora Vision SM583 (15")
CD-ROM drive (and speed and interface)	Matsushita CR-574-B (4x ATAPI)	Toshiba XM-5302B (4x ATAPI)	Toshiba XM-5302B (4x ATAPI)	Toshiba XM-5302B (4x ATAPI)	Mitsumi CRMC-FX400 (4x ATAPI)	Torisan CDR-S1G (4x ATAPI)	Torisan CDR-C3G (4x ATAPI)	Toshiba XM-3501B (4x SCSI-2)
Sound adapter	Creative Labs CT2810	Creative Labs CT2810	Creative Labs Vibra 16S	Creative Labs Vibra 16S	Creative Labs Vibra 16S	Creative Labs CT2280	Ensoniq Soundcape	Creative Labs Sound Blaster 16 SCSI
Speakers/Network adapter/Modem included	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
DOS, Windows version included	6.22, Win/W 3.11	6.22, Win/W 3.11	6.22, Win/W 3.11	6.22, Win/W 3.11	6.22, Win/W 3.11	6.22, Win/W 3.11	6.22, Win/W 3.11	6.22, Win/W 3.11
Motherboard Components								
Installed external RAM cache and type	512K asynchronous	256K asynchronous	256K synchronous	256K synchronous	256K synchronous	256K synchronous	256K synchronous	512K synchronous
Motherboard manufacturer	DTK	DTK	Intel	Intel	Intel	Intel	Intel	GST
Chip set manufacturer and model	Intel Triton	Intel Triton	Intel Triton	Intel Triton	Intel Triton	Intel Triton	Intel Triton	Intel Triton
BIOS manufacturer and version (or data)	AMI (10/10/94)	Award (5/05/95)	AMI (5/10/95)	AMI (5/10/95)	AMI (5/17/95)	AMI (3/06/95)	AMI (3/06/95)	Award (4/29/95)
Flash BIOS/Plug and Play BIOS	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Multiprocessor socket	■	■	■	■	■	■	■	■
Expandability								
Maximum RAM	128MB	128MB	128MB	128MB	128MB	128MB	128MB	128MB
Expansion-bus slots	4 ISA, 2 PCI, 1 PCI/ISA	4 ISA, 2 PCI, 1 PCI/ISA	3 ISA, 4 PCI, 1 PCI/ISA	3 ISA, 4 PCI, 1 PCI/ISA	3 ISA, 4 PCI, 1 PCI/ISA	3 ISA, 4 PCI, 1 PCI/ISA	3 ISA, 4 PCI, 1 PCI/ISA	4 ISA, 4 PCI, 1 PCI/ISA
Accessible drive bays (5.25", 3.5")	4, 1	4, 1	3, 0	3, 2	3, 2	3, 1	4, 1	4, 0
Internal drive bays (5.25", 3.5")	0, 3	0, 4	0, 2	0, 1	0, 3	0, 1	0, 4	2, 2
Power-supply wattage	250W	200W	200W	200W	300W	145W	145W	250W
Parallel, serial, mouse ports	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 1	1, 2, 1	1, 2, 0
EPP/ECP parallel interfaces supported	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Service and Support								
7-day, 24-hour live technical support	■	■	■	■	■	■	■	■
Standard warranty on parts/labor	2 years/2 years	2 years/2 years	4 years/4 years	4 years/4 years	3 years/3 years	3 years/1 year	3 years/1 year	1 year/1 year
On-site service charge (and term)	\$50 (1 year)	\$50 (1 year)	Included (4 years)	Included (4 years)	Included (1 year)	Included (1 year)	Included (1 year)	\$94 (3 years)
N/A: Not applicable. The product does not have this feature.								

Internet browser), financial-planning software, and Info Retriever, which acts as an on-line troubleshooting guide and centralizes support information. Though the mon-

itors feature integrated speakers, Austin also sent higher-quality Altec Lansing ACS5 speakers with both units (included in the above prices).

The Power Plus systems are backed by a three-year warranty and a year

of on-site service. Austin also provides 24-hour, 7-day telephone technical support.—Anush Yegyzarian

IPC Technologies Inc., Austin, TX; 800-483-9938, 512-339-3500; fax, 512-454-1357.

Circle 463 on reader service card

Maximus Computers

Magna Graphics ProMedia Pentium 120

The \$3,495 Magna Graphics ProMedia Pentium 120 from Maximus Computers is targeted toward mainstream business-graphics users. With great performance, a standard 17-inch MAG monitor, and an S3 Vision968-based graphics accelerator, this unit ably hits that target.

Maximus also offers a range of systems from the entry-level DX4/100-based Magna Media for \$1,995 (which has a built-in 14.4-Kbps fax modem and full multimedia capabilities) to the \$6,400 high-end Magna Artist Pro Multimedia, with 32MB of RAM, a 21-inch monitor, and a 128-bit graphics card (neither system reviewed here).

The ProMedia came in a tower case and featured both 256K of synchronous L2



IN SHORT
Both units offer an appealing mix of high-end components and good performance.

SERVICE & RELIABILITY IPC Technologies Inc.

Reliability	Average
Repair	Average
Tech support	Average
% needing repair	Worse than average

PCs
120- and 133-MHz Pentium PCs

Continues

HD Victoria P133	HR P5-133 Tower	HIQ Apollo 120	HIQ Apollo 133	Hymco Professional-133	IPC Austin Power Plus 120	IPC Austin Power Plus 133	Maximus Magna Graphics Pro Media Pentium 120	Micron P133 Millenia	MidWest Micro P5-133 Office PC
\$3,699 (street)	\$3,599 (list)	\$2,688 (street)	\$2,988 (street)	\$3,195 (list)	\$3,999 (list)	\$4,999 (list)	\$3,495 (list)	\$3,898 (list)	\$3,899 (list)
Pentium/133	Pentium/133	Pentium/120	Pentium/133	Pentium/133	Pentium/120	Pentium/133	Pentium/120	Pentium/133	Pentium/133
16MB	16MB EDO	16MB	16MB EDO	16MB EDO	16MB EDO	16MB EDO	16MB EDO	16MB EDO	16MB EDO
1GB ATA-2	1GB Fast ATA-2	1GB ATA-2	1GB ATA-2	1GB Fast ATA-2	1.2GB E-IDE	1.5GB E-IDE	1GB Fast ATA-2	1.5GB E-IDE	1.5GB E-IDE
Diamond Stealth 64 Video VRAM (2MB VRAM)	Diamond Stealth 64 Video VRAM (2MB VRAM)	Diamond Stealth 64 Video VRAM (2MB VRAM)	Diamond Stealth 64 Video VRAM (2MB VRAM)	ATI Winturbo (2MB VRAM)	ATI Graphics Pro (4MB VRAM)	ATI Graphics Pro (4MB VRAM)	Diamond Stealth 64 Video VRAM (2MB VRAM)	Diamond Stealth 64 Video VRAM (2MB VRAM)	ATI Winturbo (2MB VRAM)
MAG DX15Fe (15")	MAG MX15F (15")	Hitachi Superscan Pro 15 (15")	Hitachi SuperScan Pro 15 (15")	Nokia 449E (15")	Nokia 447L (17")	Nokia 447L (17")	MAG DX17F (17")	ADI MicroScan 4V (15")	Infotel 1700 (17")
Toshiba XM-5302B (4x ATAPI)	Plextor PX-63CS (6x SCSI-2)	Toshiba XM-5302B (4x ATAPI)	Toshiba XM-5302B (4x ATAPI)	Toshiba XM-5302B (4x ATAPI)	Toshiba XM-5302B (4x ATAPI)	Plextor PX-63CS (6x SCSI-2)	Mitsumi CRMC-FX400 (4x ATAPI)	Plextor PX-63CS (6x SCSI-2)	NEC CDR-272 (4x ATAPI)
Creative Labs Sound Blaster 16	Creative Labs Vibra 16S	Creative Labs Sound Blaster 16	Creative Labs Sound Blaster 16	Creative Labs Vibra 16S	Media Magic ISP-16	Media Magic ISP-16	Creative Labs Sound Blaster 16 Value	Creative Labs Sound Blaster AWE32	Creative Labs Vibra 16S
■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
6.22, WVG 3.11	6.22, WVG 3.11	6.22, WVG 3.11	6.22, WVG 3.11	6.22, WVG 3.11	6.22, WVG 3.11	6.22, WVG 3.11	6.2, WVG 3.11	6.22, WVG 3.11	6.22, WVG 3.11
256K synchronous	256K synchronous	256K asynchronous	256K synchronous	256K synchronous	256K synchronous	256K synchronous	256K synchronous	256K synchronous	256K synchronous
Super Micro Intel Triton	Intel Intel Triton	ASUSTek Intel Triton	ASUSTek Intel Triton	Intel Intel Triton	Intel Intel Triton	Intel Intel Triton	Super Micro Intel Triton	Micronix Intel Triton	Intel Intel Triton
AMI (10/10/94)	AMI (5/17/95)	Award (5/08/95)	Award (5/08/95)	AMI (5/17/95)	AMI (5/05/95)	AMI (5/05/95)	AMI (10/10/94)	Phoenix (5/03/95)	AMI (5/17/95)
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
■	■	■	■	■	■	■	■	■	■
128MB	128MB	128MB	128MB	128MB	128MB	128MB	128MB	128MB	128MB
4 ISA, 4 PCI, 1 PCI/ISA	3 ISA, 4 PCI, 1 PCI/ISA	4 ISA, 4 PCI, 1 PCI/ISA	4 ISA, 4 PCI, 1 PCI/ISA	3 ISA, 4 PCI, 1 PCI/ISA	3 ISA, 4 PCI, 1 PCI/ISA	3 ISA, 4 PCI, 1 PCI/ISA	4 ISA, 4 PCI, 1 PCI/ISA	4 ISA, 4 PCI, 1 PCI/ISA	3 ISA, 4 PCI, 1 PCI/ISA
3, 2	3, 2	3, 2	3, 2	3, 2	3, 2	3, 2	6, 2	3, 1	3, 2
0, 0	0, 3	0, 2	0, 1	0, 2	0, 2	0, 2	0, 3	0, 2	0, 0
250W	200W	250W	250W	200W	200W	200W	250W	200W	230W
1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 1	1, 2, 0
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
■	■	■	■	■	■	■	■	■	■
1 year/1 year	2 years/2 years	1 year/2 years	1 year/2 years	2 years/2 years	3 years/3 years	3 years/3 years	1 year/Lifetime	1 year/1 year	3 years/3 years
\$50 (1 year)	\$80 (2 years)	\$79.95 (2 years)	\$79.95 (2 years)	N/A	Included (1 year)	Included (3 years)	\$49 (1 year)	Included (1 year)	N/A

cache and EDO DRAM. That, combined with the Diamond Stealth 64 graphics card with 2MB of VRAM and the 1GB Fast ATA-2 hard disk, contributed to the sys-

IN SHORT

This affordable graphics workstation is a great performer with a high-quality monitor.

tem's above-average scores on all of our Windows-based tests. There was one minor design constraint, however: The system's I/O and floppy disk drive controllers were not integrated.

Maximus backs its systems with a one-year-parts, lifetime-labor warranty. One year of on-site service is \$49.—AY
Maximus Computers, Monrovia, CA; 800-888-6294, 818-305-5925; fax, 818-357-9140.

Circle 464 on reader service card

Micron Electronics Inc.

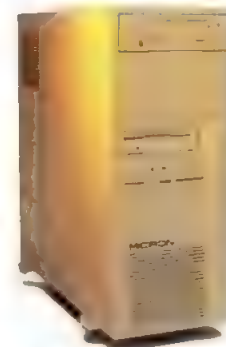
P133 Millenia

Micron Electronics has produced another terrific PC in the \$3,898 P133 Millenia (Micron's P120 Millenia was an Editors' Choice in our issue of May 30, 1995). The P133 Millenia combines great performance with a good software bundle and one of this roundup's few sextuple-speed CD-ROM drives, making it a solid choice for a high-end business-graphics workstation. For graphics-intensive work, you might want to upgrade the 15-inch monitor we received to a 17-inch model for an additional \$300.

Micron also offers its Home MPC line, geared toward the consumer market, and

the PowerStation line, targeting graphics users in small or home offices (neither is reviewed here).

This mini-tower unit came with 256K of SyncBurst cache and EDO DRAM to support its 133-MHz Pentium CPU.



These components, combined with a Diamond Stealth 64 graphics accelerator based on the S3 Vision968 chip set with 2MB of VRAM, helped the Millenia achieve above-average scores

SUMMARY OF FEATURES

120- and 133-MHz Pentium PCs

■ YES ■ NO	Mitsuba Executive Pentium-PC	Multimedia Pro Media	Multimedia Ultra Power	NMC Expert System Plus 120	NMC Expert System Plus 133	NETIS N5120P PowerStation	Percomp P120 Professional	Percomp P133 Professional
Products listed in review order								
Price (tested configuration)	\$3,955 (list)	\$2,799 (street)	\$3,775 (street)	\$3,099 (street)	\$3,299 (street)	\$2,928 (street)	\$3,649 (street)	\$4,099 (street)
Processor	Pentium/133	Pentium/120	Pentium/133	Pentium/120	Pentium/133	Pentium/120	Pentium/120	Pentium/133
Installed RAM	16MB EDO	16MB EDO	16MB	16MB EDO	16MB EDO	16MB	16MB EDO	16MB EDO
Hard disk capacity and interface	2GB SCSI-2	1.2GB E-IDE	1GB E-IDE	1GB Fast ATA-2	1GB Fast ATA-2	1.2GB E-IDE	1.2GB E-IDE	1.2GB E-IDE
Graphics adapter (and memory)	ATI Graphics Pro Turbo (4MB VRAM)	Diamond Stealth 64 Video VRAM (2MB VRAM)	Diamond Stealth 64 Video VRAM (2MB VRAM)	Cardex Trio 64 Pro (2MB DRAM)	Cardex Trio 64 Pro (2MB DRAM)	Diamond Stealth 64 Video VRAM (2MB VRAM)	Diamond Stealth 64 Video VRAM (2MB VRAM)	Diamond Stealth 64 Video VRAM (2MB VRAM)
Monitor (and diagonal screen size)	GVC M1568LR (15")	Acer AcerView 56L (15")	Acer AcerView 7176i (17")	ADI MicroScan 46P (15")	ADI MicroScan 46P (15")	Sampo Alpha-Scan 15g (15")	Socos DA-1765VA F (17")	Socos DA-1765VA F (17")
CD-ROM drive (and speed and interface)	Toshiba XM-5302B (4x ATAPI)	Acer 645A 002 (4x ATAPI)	Acer 645A 002 (4x ATAPI)	TEAC CD-55A (4x proprietary)	TEAC CD-55A (4x proprietary)	Toshiba XM-5302B (4x ATAPI)	Mitsumi CRMC-FX400 (4x ATAPI)	Plexstor PX-63CS (6x SCSI-2)
Sound adapter	Creative Labs Vibra 16S	Acer Magic S30	Creative Labs Sound Blaster AWE32	Creative Labs Sound Blaster 16 Value	Creative Labs Sound Blaster 16 Value	Creative Labs CT2260	Ensoniq Soundscape	Ensoniq Soundscape
Speakers/Network adapter/Modem included	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
DOS, Windows version included	6.22, WWVG 3.11	6.22, WWVG 3.11	6.22, WWVG 3.11	6.22, WWVG 3.11	6.22, WWVG 3.11	6.22, WWVG 3.11	6.22, WWVG 3.11	6.22, WWVG 3.11
Motherboard Components								
Installed external RAM cache and type	256K asynchronous	256K asynchronous	512K asynchronous	256K asynchronous	256K asynchronous	256K synchronous	256K synchronous	256K synchronous
Motherboard manufacturer	Intel	Acer	Acer	ASUSTek	ASUSTek	Super Micro	Super Micro	Super Micro
Chip set manufacturer and model	Intel Triton	Intel Triton	Intel Triton	Intel Triton	Intel Triton	Intel Triton	Intel Triton	Intel Triton
BIOS manufacturer and version (or date)	AMI (5/17/95)	Phoenix (4/25/95)	AMI (10/10/94)	Award (4/17/95)	Award (4/17/95)	AMI (10/10/94)	AMI (10/10/94)	AMI (10/10/94)
Flash BIOS/Plug and Play BIOS	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Multiprocessor socket	■	■	■	■	■	■	■	■
Expandability								
Maximum RAM	128MB	128MB	128MB	128MB	128MB	128MB	128MB	128MB
Expansion-bus slots	4 ISA, 4 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	4 ISA, 4 PCI, 1 PCI/ISA	4 ISA, 4 PCI, 1 PCI/ISA	4 ISA, 4 PCI, 1 PCI/ISA	4 ISA, 4 PCI, 1 PCI/ISA	4 ISA, 4 PCI, 1 PCI/ISA
Accessible drive bays (5.25", 3.5")	4, 1	3, 2	3, 2	3, 1	3, 1	3, 2	2, 2	2, 2
Internal drive bays (5.25", 3.5")	0, 4	0, 2	0, 2	0, 2	0, 2	0, 2	0, 1	0, 1
Power-supply wattage	250W	200W	200W	230W	230W	250W	230W	230W
Parallel, serial, mouse ports	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 1, 0	1, 2, 0	1, 2, 0
EPP/ECP parallel interfaces supported	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Service and Support								
7-day, 24-hour live technical support	■	■	■	■	■	■	■	■
Standard warranty on parts/labor	2 years/2 years	1 year/1 year	1 year/1 year	3 years/3 years	3 years/3 years	1 year/2 years	3 years/3 years	3 years/3 years
On-site service charge (and term)	Included (1 year)	\$45 (1 year)	\$45 (1 year)	\$69 (1 year)	\$69 (1 year)	\$70 (1 year)	Included (3 years)	Included (3 years)
N/A—Not applicable. The product does not have this feature.								

across all of our Windows-based tests.

A sextuple-speed Plextor CD-ROM drive (a \$300 option included in the above price) and a 1.6GB Enhanced IDE hard disk complete the high-end package. Mi-

cron also sent Microsoft Bookshelf and Microsoft Office Pro on CD, one of the more useful standard software bundles in this roundup.

Micron supports the Millennia with a one-year warranty on parts and labor. On-site service is also in-

cluded for the first year.—**AY**

Micron Electronics Inc., Nampa, ID; 800-438-3343, 208-463-3434; fax, 208-463-3424.

Circle 465 on reader service card

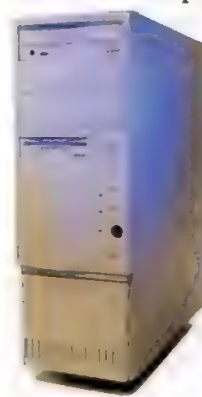
MidWest Micro

P5-133 Office PC

MidWest Micro's P5-133 Office PC is an average performer that comes with a 17-inch monitor, a 28.8-/14.4-Kbps data/fax modem, and Microsoft Office, all for \$3,899. The company targets this machine toward business and home-office users. MidWest Micro also sells a Home PC line (not reviewed here) with software bundles better suited to that market.

This Pentium/133-based mini-tower

system featured both EDO DRAM and synchronous pipelined-burst external processor cache, and came with a 1.6GB Enhanced IDE hard disk. Its 16-bit audio subsystem is integrated through a small sound card that plugs directly into a proprietary slot. To make use of its NEC quad-speed CD-ROM drive, the unit's bundled CDs include Microsoft Encarta '95 and Microsoft Office.



MidWest Micro also included a pair of Altec Lansing ACS5 speakers with the

IN SHORT
This PC blends attractive components, software, and above-average performance.

SERVICE & RELIABILITY

Micron Electronics Inc.

Reliability	Better than average
Repair	Better than average
Tech support	Better than average
% needing repair	Average

Polywell Poly 120T3	Polywell Poly 133T3	Quantex QP5/120 SM-1	Reason Square 5 LX-TR/12-120	Reason Square 5 LX-TR/IE-133	Royal Media Master	SAG STF 120	SAG STF 133	Sys Performance P133T	Targam Thunderbolt P-120E
\$3,095 (street)	\$3,295 (street)	\$3,049 (list)	\$2,975 (street)	\$3,895 (street)	\$2,895 (list)	\$3,870 (list)	\$4,315 (list)	\$2,889 (list)	\$2,775 (list)
Pentium/120	Pentium/133	Pentium/120	Pentium/120	Pentium/133	Pentium/133	Pentium/120	Pentium/133	Pentium/133	Pentium/120
16MB EDO	16MB EDO	16MB	16MB	16MB EDO	16MB	16MB	16MB	16MB EDO	16MB EDO
1 2GB E-IDE	1 2GB E-IDE	1 2GB E-IDE	1 2GB E-IDE	1 5GB E-IDE	1 5GB E-IDE	2GB SCSI-2	2GB SCSI-2	1GB Fast ATA-2	1GB E-IDE
Diamond Stealth 64 Video VRAM (2MB VRAM)	Diamond Stealth 64 Video VRAM (2MB VRAM)	ATI Graphics Xpression (2MB DRAM)	Diamond Stealth 64 DRAM (2MB DRAM)	Diamond Stealth 64 Video 3200 (2MB VRAM)	Diamond Stealth 64 Video VRAM (2MB VRAM)	Diamond Stealth 64 VRAM (2MB VRAM)	Diamond Stealth 64 VRAM (2MB VRAM)	Diamond Stealth 64 Video VRAM (2MB VRAM)	Diamond Stealth 64 Video VRAM (2MB VRAM)
Sampo Alpha-Scan 15gx (15")	Sampo Alpha-Scan 15gx (15")	MAG DX17F (17")	ADI MicroScan 4GP (15")	ADI MicroScan 5EP (17")	KFC CA1716DS (17")	ViewSonic 15G (15")	CTX 1785GMe (17")	KFC CA1507 (15")	Optquest 2000DS (14")
Toshiba XM-5302B (4x ATAPI)	Toshiba XM-5302B (4x ATAPI)	Toshiba XM-5302B (4x ATAPI)	Toshiba XM-5302B (4x ATAPI)	Plextor PX-63CS (6x SCSI-2)	Plextor PX-63CS (6x SCSI-2)	Sony CDU76S (4x SCSI)	Sony CDU76S (4x SCSI)	Toshiba XM-3601B (4x SCSI-2)	Toshiba XM-5302B (4x ATAPI)
Creative Labs Sound Blaster 16 Value	Creative Labs Sound Blaster 16 Value	Biostar Mad 16 Pro	Crystal Lake Crystalclear Wavetable	Turtle Beach Monte Carlo	Adaptec AMM-1572	Creative Labs Sound Blaster AWE32	Creative Labs Sound Blaster AWE32	Creative Labs Sound Blaster 16 SCSI-2	Creative Labs CT2260
■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■
6.22, WFWG 3.11	6.22, WFWG 3.11	6.22, WFWG 3.11	6.22, WFWG 3.11	6.22, WFWG 3.11	6.22, WFWG 3.11	6.22, WFWG 3.11	6.22, WFWG 3.11	6.22, WFWG 3.11	6.22, WFWG 3.11
256K synchronous	256K synchronous	256K asynchronous	256K synchronous	256K synchronous	256K synchronous	256K synchronous	256K synchronous	512K synchronous	256K synchronous
Tyan	Tyan	Biostar	Intel	Intel	Gigabyte	Super Micro	Super Micro	Tyan	Tyan
Intel Triton	Intel Triton	Intel Triton	Intel Triton	Intel Triton	Intel Triton	Intel Triton	Intel Triton	Intel Triton	Intel Triton
Award (4/13/95)	Award (4/29/95)	Award (3/08/95)	AMI 2/03/95)	AMI (5/17/95)	Award (5/05/95)	AMI (10/10/94)	AMI (10/10/95)	Award (4/29/95)	Award (4/13/95)
■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■
■	■	■	■	■	■	■	■	■	■
128MB	128MB	128MB	128MB	128MB	128MB	128MB	128MB	128MB	128MB
4 ISA, 4 PCI	4 ISA, 4 PCI	4 ISA, 3 PCI	3 ISA, 2 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	4 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	4 ISA, 4 PCI	4 ISA, 4 PCI
3.2	3.2	5.0	3.0	3.1	3.2	6.0	6.0	3.2	3.2
0.2	0.2	1.5	0.2	0.2	0.3	4.0	4.0	0.2	0.2
230W	230W	200W	200W	200W	230W	300W	300W	250W	200W
1.2, 0	1.2, 0	1.2, 0	1.2, 0	1.2, 0	1.2, 0	1.2, 0	1.2, 0	1.2, 0	1.2, 0
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
■	■	■	■	■	■	■	■	■	■
3 years/5 years	3 years/5 years	1 year/1 year	6 years/6 years	6 years/6 years	1 year/Lifetime	1 year/1 year	1 year/1 year	1 year/1 year	3 years/3 years
\$75 (1 year)	\$75 (1 year)	Included (1 year)	\$49 (1 year)	\$49 (1 year)	\$200 (3 years)	\$90 (1 year)	\$90 (1 year)	\$195 (1 year)	\$65 (1 year)

system (ACS31 speakers with a subwoofer are available for \$60 more).

The unit produced average scores for its processor class on both our Winstone 95 and Disk WinMark 95 tests. The machine's

graphics subsystem, based on the ATI Winturbo graphics accelerator with 2MB of VRAM, could not keep up with those of others in this roundup, and pulled the unit's Graphics WinMark 95 score to below average.

MidWest Micro

offers a three-year warranty on parts and labor with the system. On-site service is not available, however.—AY

MidWest Micro, Fletcher, OH; 800-728-8582, 513-368-2309; fax, 800-562-6622.

Circle 466 on reader service card

Mitsuba Corp.

Executive Pentium-PC

Mitsuba aims its Executive Pentium-PC, with a street price of \$3,955, at business users who need a power system. Its components—including a 17-inch monitor, a 2GB Fast/Wide SCSI-2 hard disk, and an ATI graphics card with 4MB of VRAM—support that aim, but its performance and home-oriented software bundle of games and a multimedia

encyclopedia don't.

This 133-MHz Pentium system came with EDO DRAM but it also used 256K of asynchronous SRAM instead of synchronous SRAM, the latter a more efficient solution used by many tested systems. This component choice contributed

to a below-average score on our Winstone 95 tests.

Although the unit had an ATI Graphics Pro Turbo graphics board, its performance could not match that of newer graphics cards based on



IN SHORT	
Welcome extras such as a 17-inch monitor and fax modem round out this office system.	
SERVICE & RELIABILITY	
MidWest Micro	
Reliability	Better than average
Repair	Average
Tech support	Average
% needing repair	Average

SUMMARY OF FEATURES

120- and 133-MHz Pentium PCs



■ YES ■ NO

Products listed in review order

	Targem Thunderbolt P-133E	Tangent MediaStar 5120	Tangent MediaStar 5133	Tatung TCS-S210	Tri-CAD Pro-17 Workstation 120	Tri-CAD 133/55 Workstation	Unitek UT-P120 Lightning
Price (tested configuration)	\$3,275 (list)	\$2,795 (list)	\$3,295 (list)	\$2,899 (list)	\$5,195 (list)	\$5,495 (list)	\$3,095 (street)
Processor	Pentium/133	Pentium/120	Pentium/133	Pentium/120	Pentium/120	Pentium/133	Pentium/120
Installed RAM	16MB EDO	16MB EDO	16MB EDO	16MB	16MB	16MB EDO	16MB EDO
Hard disk capacity and interface	1GB Fast ATA-2	1GB Fast ATA-2	1GB Fast ATA-2	1.2GB E-IDE	1.5GB E-IDE	1.5GB E-IDE	1.5GB E-IDE
Graphics adapter (and memory)	Matrox Millennium (2MB VRAM)	Diamond Stealth 64 Video VRAM (2MB VRAM)	Diamond Stealth 64 Video VRAM (2MB VRAM)	Integrated S3 Trio 64 (2MB DRAM)	ATI Graphics Pro Turbo (2MB VRAM)	ELSA Winner 2000Pro (4MB VRAM)	Diamond Stealth 64 Video VRAM (2MB VRAM)
Monitor (and diagonal screen size)	Optquest 2000DS (14")	ADI MicroScan 4GP (15")	ADI MicroScan 5EP (17")	Tatung CM-15VBR (15")	Viewsonic 1782-2 (17")	Viewsonic 1782-2 (17")	ViewSonic 17GA (17")
CD-ROM drive (and speed and interface)	Plextor PX-63CS (6x SCSI-2)	TEAC CD-55A (4x proprietary)	TEAC CD-55A (4x proprietary)	TEAC CD-55A (4x proprietary)	Plextor PX-63CS (6x SCSI-2)	Plextor PX-63CS (6x SCSI-2)	Toshiba XM-5302B (4x ATAPI)
Sound adapter	Creative Labs Sound Blaster 16 SCSI	Media Magic ISP-16	Media Magic IPS-16	Creative Labs Sound Blaster 16	Media Magic ISP-16	IPC Telemetry-32	Creative Labs Vibra 16S
Speakers/Network adapter/Modem included	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
DOS, Windows version included	6.22, WWVG 3.11	6.22, WWVG 3.11	6.22, WWVG 3.11	6.22, WWVG 3.11	6.22, WWVG 3.11	6.22, WWVG 3.11	6.22, WWVG 3.11
Motherboard Components							
Installed external RAM cache and type	256K synchronous	256K synchronous	512K synchronous	256K asynchronous	256K asynchronous	256K synchronous	256K asynchronous
Motherboard manufacturer	ASUSTek	Tyan	Tyan	Tatung	Intel	Intel	Intel
Chip set manufacturer and model	Intel Triton	Intel Triton	Intel Triton	VLSI VL82C59x	Intel Triton	Intel Triton	Intel Triton
BIOS manufacturer and version (or date)	Award (3/15/95)	Award (4/29/95)	Award (4/29/95)	Phoenix (5/30/95)	AMI (3/15/95)	AMI (3/15/95)	AMI (5/17/95)
Flash BIOS/Plug and Play BIOS	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Multiprocessor socket	■	■	■	■	■	■	■
Expandability							
Maximum RAM	128MB	128MB	128MB	728MB	128MB	128MB	128MB
Expansion-bus slots	3 ISA, 3 PCI, 1 PCI/ISA	4 ISA, 4 PCI	4 ISA, 4 PCI	3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 4 PCI, 1 PCI/ISA	3 ISA, 4 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA
Accessible drive bays (5.25", 3.5")	4, 1	2, 1	2, 1	2, 2	3, 2	3, 2	3, 1
Internal drive bays (5.25", 3.5")	0, 3	0, 2	0, 2	0, 3	0, 2	0, 2	0, 1
Power-supply wattage	230W	230W	230W	150W	200W	200W	230W
Parallel, serial, mouse ports	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 1	1, 2, 0	1, 2, 0	1, 2, 0
EPP/ECP parallel interfaces supported	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Service and Support							
7-day, 24-hour live technical support	■	■	■	■	■	■	■
Standard warranty on parts/labor	3 years/3 years	3 years/3 years	3 years/3 years	1 year/2 years	2 years/Lifetime	2 years/Lifetime	1 year/1 year
On-site service charge (and term)	\$65 (1 year)	Included (1 year)	Included (1 year)	N/A	\$50 (1 year)	\$50 (1 year)	\$75 (1 year)

N/A—Not applicable. The product does not have this feature.

the S3 Vision968 chip set. This pulled the unit's Graphics WinMark 95 score to below average and also contributed to the low Winstone score. This machine produced an above-average Disk WinMark 95 score, no doubt boosted by Microsoft Windows for Workgroups and the system's Fast/Wide SCSI-2 hard disk with a 2MB on-disk buffer.

IN SHORT
Below-average Winstone results counterbalance stellar disk performance and a 17-inch monitor.

The system's multimedia components included a Toshiba quad-speed CD-ROM drive and a 16-bit Creative Labs Vibra 16S sound card attached to a special connector on the unit's Intel Triton-based motherboard.

Mitsuba supports the Executive Pentium-PC with a two-year warranty on parts and labor. On-site service is also included with the system for the first year. Telephone technical support is available 24 hours, 7 days.—AY

Mitsuba Corp., La Verne, CA; 800-648-7822, 909-392-2000; fax, 909-392-2021.
Circle 467 on reader service card

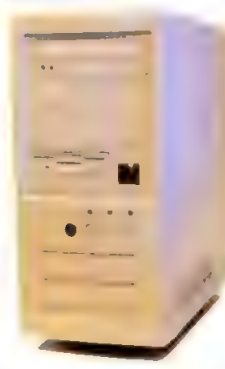
Multiwave Technology

Pro Media Ultra Power

The \$3,775 Ultra Power and the \$2,799 Pro Media from Multiwave Technology are solid performers and have quality components under the

hood. This combination should please the intended market for these systems: Fortune 500 companies. Multiwave is a fairly new direct-market PC division of Anson, which has primarily sold electronics components since 1989.

The Pentium/133-based Ultra Power features 512K of L2 cache and 16MB of EDO DRAM. Other pedigree parts include a Diamond Stealth 64 graphics accelerator with the S3 Vision968



USA Flex Flex Multimedia System PT-133	Vaktron Power Station P-133	ZDS Z-Station GT	Zenon Dream Media P5-120	Zenon Dream Media P5-133
\$4,199 (street)	\$2,995 (list)	\$5,100 (list)	\$2,949 (list)	\$3,249 (list)
Pentium/133	Pentium/133	Pentium/120	Pentium/120	Pentium/133
16MB EDO	16MB EDO	16MB	16MB EDO	16MB EDO
1GB ATA-2	1.2GB E-IDE	1.2GB E-IDE	1GB Fast ATA-2	1GB Fast ATA-2
Diamond Stealth 64 Video VRAM (2MB VRAM)	STB Powergraph 64 (2MB DRAM)	Integrated S3 Trio 64 (2MB DRAM)	Diamond Stealth 64 Video VRAM (2MB VRAM)	Diamond Stealth 64 Video VRAM (2MB VRAM)
Panasonic C-1791E (17")	ADI MicroScan 5AP (17")	Zenith Data Systems 447E (17")	MAG DX15Fe (15")	MAG DX15Fe (15")
Toshiba XM-5302B (4x ATAPI)	Toshiba XM-5302B (4x ATAPI)	Toshiba XM-5302B (4x ATAPI)	Pioneer DR-UA124X (4x ATAPI)	Pioneer DR-UA124x (4x ATAPI)
Turtle Beach Tropaz	Creative Labs Sound Blaster AWE32	Creative Labs Sound Blaster 16 Value	Creative Labs Sound Blaster AWE32	Creative Labs Sound Blaster 16 AWE
■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
6.22, W/WG 3.11	6.22, W/WG 3.11	6.22, W/WG 3.11	6.22, W/WG 3.11	6.22, W/WG 3.11
256K synchronous	256K synchronous	256K asynchronous	256K synchronous	256K synchronous
Super Micro	Super Micro	Intel	Super Micro	Super Micro
Intel Triton	Intel Triton	Intel Triton	Intel Triton	Intel Triton
AMI (10/10/94)	AMI (10/10/94)	AMI (5/08/95)	AMI (10/10/94)	AMI (10/10/94)
■ ■	■ ■	■ ■	■ ■	■ ■
■	■	■	■	■
128MB	128MB	128MB	128MB	128MB
3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 2 PCI, 1 PCI/ISA	4 ISA, 4 PCI, 1 PCI/ISA	4 ISA, 4 PCI
3.2	3.2	2.1	3.2	3.2
0.2	0.3	0.1	0.3	0.3
200W	250W	145W	230W	250W
2, 3, 0	1, 2, 0	1, 2, 1	1, 2, 0	1, 2, 0
■ ■	■ ■	■ ■	■ ■	■ ■
■	■	■	■	■
3 years/Lifetime	1 year/1 year	3 years/3 years	1 year/Lifetime	1 year/Lifetime
\$49 (1 year)	\$50 (1 year)	Included (1 year)	\$50 (1 year)	\$50 (1 year)

chip set and 2MB of VRAM, a 17-inch monitor, and a 14.4-Kbps fax modem with voice mail and full-duplex speaker (features perhaps more useful for small/home offices than for large corporations). The Pentium/120-based Pro Media had only 256K of L2 cache, standard memory, and a 15-inch monitor. This machine came with the same graphics card and fax modem as the Ultra Power, however.

Both systems were good performers

IN SHORT

Solid performance and pedigree parts will please the business user, especially in small offices.

on our benchmark tests. The Ultra Power had extra cache (most Pentium/133-based systems

had 256K) but the cache was asynchronous, which is slower than synchronous cache, and so did not make a significant impact on its test scores: Both Winstone 95 and Graphics WinMark 95 scores were average; its Disk WinMark 95 score was above average for its class. The Pro Media had average scores for the unit's class across all of our Windows-based tests.

Multiwave offers a one-year parts-and-labor warranty with the two systems. On-site service is available for \$45 for one year.—MEB

Multiwave Technology, City of Industry, CA; 800-234-3358, 818-330-7030; fax, 818-333-4609.

Circle 468 on reader service card

National MicroComputers

NMC Expert System Plus 120 NMC Expert System Plus 133

National MicroComputers' NMC Expert System Plus 133, with a street price of \$3,299, and NMC Expert System Plus 120, with a street price of \$3,099, have only one real difference between them—their CPUs. Given the units' similarity, you may be better off with the 120: It fared well within its CPU class while the 133 posted below-average scores within its group on all of our tests. NMC targets high-end business and graphics users with these systems.



IN SHORT

Poor performance from the Expert System Plus 133 makes the 120 a better buy.

The two NMC systems came in identical, thumbscrew-equipped tower cases. Both came with 1GB hard disks, EDO DRAM, and Cardex graphics accelerators based on S3's Trio 64 chip set. The single unusual feature of these systems is on the ASUSTek motherboard each system uses. It has a PCI slot with a proprietary extension that can accommodate a standard PCI card or a special combination graphics-and-sound card. These special cards are not yet available.

The 120 managed average scores in its category across our Windows-based tests, but the 133 posted all below-average scores compared with the others in its class. Each machine used asynchronous SRAM, which contributed significantly to each unit's low CPUmark₁₆ score and subsequent below-average scores on our Windows-based tests.

Though the system has a quad-speed CD-ROM drive and didn't seem to have driver or caching problems, its measured throughput was just below 500 KBps, rather than the expected 600 KBps.

NMC offers a three-year warranty; one year of on-site service is available for \$69.—AY

120- and 133-MHz Pentium PCs

National MicroComputers, Murray, UT; 800-800-4662, 801-265-3700; fax, 801-265-3783.

Circle 469 on reader service card

NETiS Technology Inc.

N5120P PowerStation

The N5120P PowerStation from direct vendor NETiS Technology, with a street price of \$2,928, is aimed at corporate power users. The unit serves its target audience well, with great performance and a good choice of components.

The mini-tower system is built around a 120-MHz Pentium processor, which is supported by 256K of pipelined-burst cache. Its Enhanced IDE 1.2GB hard disk and Diamond Stealth 64, S3 Vision968-based graphics card helped it achieve above-average results on both our Disk WinMark 95 and Graphics WinMark 95 tests. The unit's Winstone 95 score was average.

The system includes a Toshiba quad-speed CD-ROM drive and 16-bit Creative

Labs sound card, which is capable of wavetable and FM synthesis. A minor quibble: The unit uses a SuperMicro motherboard that lacks integrated I/O and floppy disk drive controllers; the shared PCI/ISA slot was used by the I/O controller card.

The system comes with a one-year-parts, two-year-labor warranty.

One year of on-site service is \$70.—**AY**
NETiS Technology Inc., Milpitas, CA; 800-577-7526, 408-263-0368; fax, 408-263-4624.

Circle 470 on reader service card

Percomp MicroSystems Inc.

P120 Professional
P133 Professional

Both Percomp PCs offer good performance and a well-chosen set of components, including 17-inch monitors, Sony speakers with a subwoofer, and Lotus SmartSuite. These units are further

distinguished by one of the better service offerings around. The P133 Professional, with a street price of \$4,099, also includes a sextuple-speed CD-ROM drive; the P120 Professional has a street price of \$3,649 and includes a quad-speed CD-ROM drive.

These PCs are aimed at the high-end multimedia market. Percomp is a year-old, mail-order-only division of J.M. Computers (which also sells its systems under the Simply Better Computers label in retail channels), and targets mainly small-office/home-office users and home consumers with its systems.

Both systems performed well on our tests. The P120 posted above-average scores on both our Winstone 95 and Graphics WinMark 95 tests and an average

score on our Disk WinMark 95 tests. The P133 had an above-average Graphics WinMark score, thanks in part to its S3 Vision968-based graphics card, which was used by each system, and average scores on our other Windows-based tests.

Percomp backs the Professionals with a three-year warranty; on-site service is included for all three years. The company also provides 24-hour, 7-day telephone technical support for both hardware and software—even if you didn't buy the software from Percomp.—**AY**

Percomp MicroSystems Inc., Richardson, TX; 800-856-6688, 214-234-2198; fax, 214-234-8658.

Circle 471 on reader service card

Polywell Computers Inc.

Poly 120T3
Poly 133T3

The Pentium/133-based Poly 133T3, with a street price of \$3,295, and the Pentium/120-based Poly 120T3, with a street price of \$3,095, from Polywell Computers, are aimed at different audiences. While the Poly 133T3 is intended for

use as a multimedia authoring system and can be custom-configured by the vendor with software-editing packages and video-capture boards, the Poly 120T3 is aimed at mainstream corporate power users. Both were strong graphics performers, but neither delivered good disk performance.

The performance of these two mini-tower units was hampered by their Conner CFS 1275A Enhanced IDE hard disks, which contributed to below-average Disk WinMark 95 scores. These budget drives will get the job done but could not compete with others in this roundup. The 133T3's Winstone 95 score was below average, but the 120T3 posted an average Winstone score. Thanks to their S3 Vision968-based graphics cards, both systems earned above-average Graphics WinMark 95 scores.

Both Polywell machines also came with 15-inch monitors and quad-speed CD-ROM drives. To upgrade either system to a 17-inch monitor and a sextuple-speed CD-ROM drive costs an additional \$685.

The systems come with an exceptional warranty, which covers three years on parts and five years on labor. On-site service costs \$75 for the first year.—**AY**
Polywell Computers Inc., So. San Francisco, CA; 800-999-1278, 415-583-7222; fax, 415-583-1974.

Circle 472 on reader service card

Quantex MicroSystems Inc.

QP5/120 SM-1

Quantex MicroSystems' \$3,049 QP5/120 SM-1 offers a lot for the money, including a 28.8-Kbps fax modem, a quad-speed CD-ROM drive, a 17-inch monitor, and a good software bundle. Its performance was mostly average, and it should adequately meet the needs of its small-office/home-office target market.

Quantex also sells the QB5/120 WS-1 (not reviewed), a workstation designed



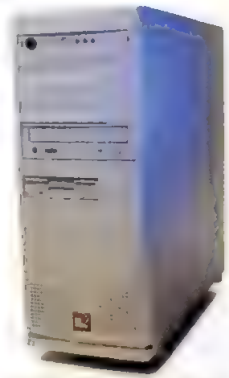
IN SHORT

Strong performance and well-chosen components make this an attractive corporate PC.



IN SHORT

Multimedia users will enjoy good performance, high-end components, and complete service.



IN SHORT

Uneven results on our benchmark tests offset the units' appealing prices.



WINNER IN 1993.

WINNER IN 1994.

WINNER IN 1995.

NOTICE A TREND HERE?

For the third year in a row, a TI TravelMate™ notebook has won the PC Magazine Editors' Choice award. This year, the TravelMate 5000 won for best full-featured notebook.

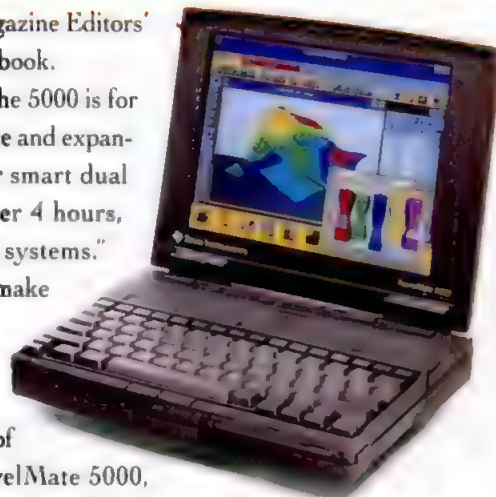
Speaking about this extraordinary portable computer, the editors said, "...the 5000 is for mobile users needing desktop replacements. The 5000 provides the performance and expansion capabilities to hit its target."



They marveled how our smart dual lithium ion battery system was unmatched – "At just over 4 hours, the 5000 posted the longest WinDrain time of all tested systems."

They noted how easy our expansion ports are to access and make PC cards "mercifully easy to remove."

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pentium

 **TEXAS
INSTRUMENTS**

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CIRCLE 246 ON READER SERVICE CARD

120- and 133-MHz Pentium PCs



IN SHORT

Above-average components for a great price distinguish this average performer.

for mainstream corporate users that lacks the SM-1's software bundle and sound card but has a better graphics subsystem. Quantex is a direct vendor that has been selling PCs mostly to the small-office/home-office market since 1991.

The SM-1 garnered average scores on our Winstone 95 and Disk

WinMark 95 tests. Its Graphics WinMark 95 score, however, was below average for the Pentium/120 group. The unit used a graphics card based on the ATI Mach 64 chip set with 2MB of DRAM; the card is good but could not help the system keep up with those using cards based on S3's Vision968 chip set with VRAM.

The unit's use of asynchronous SRAM lowered its CPUmark₁₆ score (though the score was still average) and affected its other Windows-based test scores as well. The Triton-based motherboard supports upgrades to pipelined-burst cache and EDO DRAM, but neither is available directly from Quantex.

Preloaded on the system's 1.2GB hard disk were Novell Perfect Office and Quicken Financial Suite. Quantex also sent a pair of Altec Lansing ACS5 speakers (an upgrade to ACS31 speakers and an Ensoniq wavetable sound card is \$99).

Quantex offers a one-year warranty, with on-site service included.—AY
Quantex MicroSystems Inc., Somerset, NJ; 800-760-9001, 908-563-4166; fax, 908-563-0407.

Circle 473 on reader service card

Reason Technology Inc.

Square 5 LX-TR/IE-120 Square 5 LX-TR/IZ-133

Reason Technology has sold Pentium systems primarily to businesses, but plans to broaden that focus with the Pentium/120-based Square 5 LX-TR/IZ-120, which targets home users and has a street price of \$2,975. The Pentium/133-

based Square 5 LX-TR/IE-133, with a street price of \$3,895, will continue to be aimed at the business market. Both are good machines with average performance.

The LX-TR/IE-133 mini-tower had the more impressive component collection, including a 17-inch ADI monitor, a sextuple-speed CD-ROM drive, 256K of pipelined-burst cache, and EDO DRAM. The LX-TR/IZ-120 desktop downgrades that list a bit with a 15-inch ADI monitor, a quad-speed CD-ROM drive, 256K of synchronous external processor cache, and standard RAM.

The LX-TR/IE-133 delivered an average Winstone 95 score for its class. Using a 1.6GB Enhanced IDE hard disk and a Diamond Stealth 64 graphics accelerator with



IN SHORT

These are well-priced corporate workstations with sterling performance for the business market.

2MB of VRAM, it also produced average Disk WinMark 95 and Graphics WinMark 95 scores.

The LX-TR/IZ-120 came with a 1.2GB hard disk and a Diamond Stealth 64 card with DRAM rather than VRAM but still produced average Winstone and Graphics WinMark scores. Its Disk WinMark

performance was poor, however.

Reason Technology supports the units with a six-year parts-and-labor warranty, with one year of on-site service \$49.—CM
Reason Technology Inc., Minneapolis, MN; 800-800-4860, 612-780-4792; fax, 612-780-4797.

Circle 474 on reader service card

Royal Computer Inc.

Media Master

Considering its robust set of components and \$2,895 price tag, we have to conclude that Royal Computer's Media Master is an appealing choice. Its performance was reasonable even though it did not stand out on our benchmark tests. Royal markets the system toward Windows power users.

This short mini-tower is a bit cluttered

inside but does offer a 1.5GB Enhanced IDE Western Digital hard disk, 256K of synchronous cache, and a sextuple-speed Plexor SCSI-2 CD-ROM drive. Its 17-



IN SHORT

An excellent buy, the Media Master includes good software and a 6X CD-ROM drive.

inch monitor is driven by an S3 Vision968-based Diamond Stealth 64 graphics accelerator—used by this roundup's top performers. The unit also ships with a good software package, including Microsoft Encarta '95, Microsoft Money, and Microsoft Works.

On our benchmark tests, the Media Master delivered average scores for its class on all

of our Windows-based tests.

Royal Computer supports the Media Master with a one-year-parts and a lifetime-labor warranty. You may purchase three years of on-site service for an additional \$200.—CM

Royal Computer Inc., City of Industry, CA; 800-486-0008, 818-855-5077; fax, 818-330-2717.

Circle 475 on reader service card

SAG Electronics

STF 120 STF 133

Primarily a vendor of RAID and mass-storage solutions, SAG Electronics entered the Intel-based PC market about a year ago. We tested SAG's STF 120, with a street price of \$3,870, and STF 133, with a street price of \$4,315, both of which are aimed at high-end graphics users who need heavy-duty storage capacity. These units serve their target well:

Both were strong graphics performers, and both came with removable 2GB Fast/Wide SCSI-2 hard disks

that helped them produce the highest Disk WinMark 95 scores we've ever recorded.

The SAG tower PCs are virtually

IN SHORT

Both SAG units deliver strong graphics performance and heavy-duty storage capacity.

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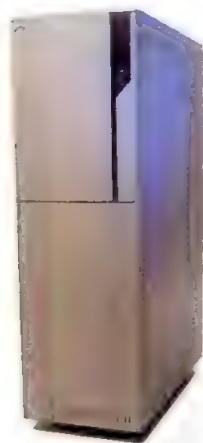
Carol Peters, Reprints Manager; Ziff-Davis Publishing Company.

ZIFF-DAVIS REPRINTS

ONE PARK AVENUE 16th FLOOR NEW YORK NEW YORK 10016

120- and 133-MHz Pentium PCs

identical except for their CPUs and monitors (a 15-inch with the Pentium/120-based STF 120 and a 17-inch with the Pentium/133-based STF 133). Both came with quad-speed CD-ROM drives and Diamond Stealth 64 graphics accelerators. These units' hard disks were located in rail-mounted, lockable caddies to facilitate removal (all front-accessible drive bays have this feature).



The units performed well, especially on our Disk WinMark 95 tests, producing the top two scores in this roundup—thanks to their Quantum XP32150W Fast/Wide SCSI-2 hard disks. The STF 133 had average scores on our other Windows-based tests; the STF 120 did better,

with above-average scores on our Winstone 95 and Graphics WinMark 95 tests.

SAG backs these units with one-year warranties; on-site service for one year is \$90.—Carol Venezia

SAG Electronics, North Andover, MA; 800-989-3475; fax, 508-689-0180.

Circle 476 on reader service card

Sys Technology Inc.

Sys Performance P133T

If you're looking for a top-performing, reasonably priced 133-MHz Pentium PC, check out the Sys Performance P133T, with a list price of \$3,299 and a street price of \$2,889, from direct vendor Sys Technology. This machine produced top-five scores on all Windows-based benchmark tests, including the best Winstone 95 score in this roundup. The P133T is targeted toward high-end corporate and small-business users, and will serve either customer well. (A Pentium/90 version of this unit was an Editors' Choice in our roundup of September 27, 1994.)

Sys did a superb job of optimizing the P133T's cutting-edge components. Inside this unit's mini-tower case you'll find a Pentium/133 CPU coupled with 512K of 8-nanosecond, synchronous-burst SRAM and EDO DRAM; a Dia-

mond Stealth 64 graphics accelerator that uses S3's speedy new Vision968 chip set and 2MB of VRAM; and a 1GB Quantum Fireball Enhanced IDE hard disk (one of this roundup's disk speed demons); all running under Microsoft Windows for Workgroups. The result was the top Winstone score of this roundup, and above-average Disk WinMark 95, Graphics WinMark 95, and CPU mark 16 scores.



IN SHORT

This 133-MHz powerhouse mates top Winstone performance with a reasonable price.

Sys completes this package with a quad-speed CD-ROM drive, a Creative Labs Sound Blaster 16 audio card, a 15-inch monitor, and a one-year part-and-labor warranty. Fee-based on-site service is also available.—CV

Sys Technology Inc., Cypress, CA; 800-613-9963, 714-821-3900; fax, 714-821-9592.

Circle 477 on reader service card

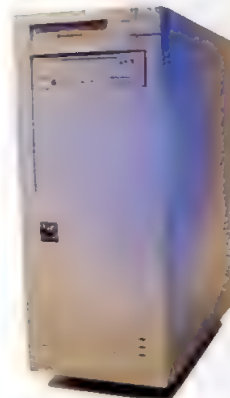
Tagram System Corp. Thunderbolt P-120E Thunderbolt P-133E

The \$2,775 Thunderbolt P-120E and \$3,275 Thunderbolt P-133E, from direct vendor Tagram System Corp., provide a winning combination of strong performance and impressive components for competitive prices. These systems are targeted mainly toward home users to serve as home office or high-end family computers.

The P-120E came in a desktop case, with a quad-speed CD-ROM drive and a 1GB hard disk. The unit's Tyan motherboard integrated 256K of pipelined-burst SRAM, EDO DRAM, and Intel's Triton chip set. Combined with the Diamond Stealth 64 graphics accelerator (based on S3's new Vision968 chip set), the P-120E produced above-average scores on all Windows-based benchmark tests.

The P-133E was housed in a mini-tower case. It came with a sextuple-speed CD-ROM drive, a 1GB hard disk, and a Matrox

Millennium graphics adapter with 2MB of Window RAM (not affiliated with Microsoft Windows). This system used a different motherboard than the P-120E, but its motherboard also featured the Triton chip set, EDO DRAM, and synchronous pipelined-burst external processor cache. This combination of components resulted in above-average Disk and Graphics WinMark 95 scores and an average Winstone 95 score.



IN SHORT

Both Thunderbolts are strong performers and have some of the lowest prices in their categories.

Tagram backs these units with a three-year part-and-labor warranty. One year of on-site service is available for an additional \$65.—CV

Tagram System Corp., Tustin, CA; 800-824-7267, 714-258-3222; fax, 714-258-3220.

Circle 478 on reader service card

Tangent Computer Inc.

MediaStar 5120 MediaStar 5133



The \$2,595 MediaStar 5120 and \$3,095 MediaStar 5133, from Tangent Computer, offer the best of all worlds. Both PCs have uniquely integrated, user-friendly desktop cases and are not only top-flight performers but are also priced very aggressively.

At first glance you'll notice that the MediaStars are slightly taller than the average desktop PC.

That's because the cases feature integrated speakers, which produce sound as good as

IN SHORT

Top performance, great warranties, and aggressive prices make both Tangents winners.





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SAG TERABYTE



PC RACK MOUNT SOLUTIONS



STACKABLE MODULAR DRIVE SOLUTION



DUAL MOTHERBOARD 16-BAY 400 WATT REDUNDANT POWER

GRAPHICS POWER STATION 133MHZ

- IMAGINE 128, FASTEST, GRAPHICS, DRIVE, AND MOTHERBOARD
- 1 INTEL 133 MHZ PENTIUM
- 256K PIPELINE SRAM CACHE
- TRINITY CHIPSET "EDO MEMORY OPTION"
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that of decent standalone speakers. But that's not all: On the front of the case, for easy access, you'll find the volume control; jacks for a microphone, auxiliary line out, video I/O, and headphones; a MIDI port; and amplifier and bass controls.

The MediaStars are also well stocked inside. Each features a Quantum Fireball 1GB hard disk, EDO DRAM coupled to Intel's Triton chip set, 8-nanosecond synchronous-burst SRAM (256K on the 5120 and 512K on the 5133), and a Diamond Stealth 64 graphics accelerator based on S3's Vision968 chip set.

This combination of components proved to be a winner for the MediaStars. Both machines produced top-five scores in their respective CPU groups on all of our Windows-based tests.

The systems are well supported by three-year warranties.—CV

Tangent Computer Inc., Burlingame, CA; 800-800-5550, 415-342-9388; fax, 415-342-9380.

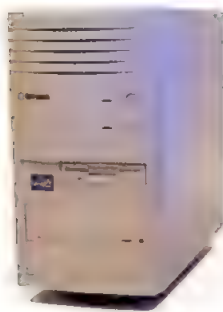
Circle 479 on reader service card

Tatung Company of America Inc.

TCS-5210

The 120-MHz Pentium-based TCS-5210 marks the reentry of monitor vendor Tatung into the PC systems market after a one-year absence. This mini-tower unit is sold through dealers to small-business and corporate users. With a street price of \$2,899, the unit is aggressively priced, but its Winstone 95 score was low, detracting from its appeal.

The TCS-5120's below-average Winstone and Graphics WinMark 95 scores can be attributed to a couple of chip sets. The unit's performance was hobbled by a combination of a nonoptimized VLSI core-logic chip set, 256K of buffered write-through L2 cache (faster systems used write-back cache), and an in-



IN SHORT

Poor Windows performance and a cluttered design detract from an attractive price tag.

tegrated graphics subsystem based on S3's budget-oriented Trio 64 chip set with 2MB of DRAM. Using a 1.3GB Enhanced IDE hard disk, the unit posted an average Disk WinMark 95 score.

This unit's Tatung motherboard employs a riser-card design, which limits the number of expansion slots and creates a cluttered interior. The system's six SIMM slots are all underneath the drive cage, making upgrades difficult.

The TCS-5210 came with a quad-speed CD-ROM drive and a 15-inch Tatung monitor with built-in speakers. Tatung backs the unit with a two-year parts, one-year labor warranty.—CV
Tatung Company of America Inc., Long Beach, CA; 800-829-2850, 310-637-2105; fax, 310-637-8484.

Circle 480 on reader service card

Tri-Star Computer

Tri-CAD Pro-17 Workstation 120 Tri-CAD 133/55 Workstation

The Tri-CAD 133/55 Workstation and Tri-CAD Pro-17 Workstation 120, from Tri-Star Computer, are aimed at Tri-Star's primary customers: high-end CAD and graphics users. With a 17-inch monitor and 1.6GB hard disk, each system has the hardware to suit this purpose. Performance was another story: Though both units were competitive performers on our Winstone 95 tests, they fell short on our graphics tests. At \$5,195 for the Pro-17 Workstation 120 and \$5,495 for the 133/55 Workstation, the units are also among the most expensive in this roundup.

The Tri-Star pair used different graphics cards, both of which contributed to the units' below-average Graphics WinMark 95 scores. The Pro-17 Workstation 120 used an ATI card, while the 133/55 Workstation used an Elsa card. Both

were outgunned by this roundup's graphics leader, the Diamond Stealth 64 graphics card.

However, the Elsa graphics card does have features critical to Tri-Star's target CAD audience, such as its bird's-eye zoom function in AutoCAD and its sophisticated driver, which accelerates pans, zooms, and redraws under AutoCAD. The card came with 4MB of VRAM—so it is capable of 1,024-by-768 resolution at 16 million colors (or 1,280-by-1,024 at 65,000 colors)—and offers full driver support for ProEngineer and Microstation as well as AutoCAD.

Each system also included a sextuple-speed CD-ROM drive and a Media Magic sound card—the ISP 16 card for the 120-MHz model and the Telemetry 32 card, which supports telephony functions, for the 133-MHz model. A two-year-parts and a lifetime-labor warranty covers each unit.—CV

Tri-Star Computer, Tempe, AZ; 800-473-6223, 602-731-4926; fax, 602-731-4979.

Circle 481 on reader service card



Unitek Technology Inc.

UT-P120 Lightning

The UT-P120 Lightning, from direct vendor Unitek Technology, provides an amazing amount of hardware for the affordable street price of \$3,095. This system also delivers in the performance arena, posting test scores on a par with or better than its 120-MHz Pentium competition. The unit is aimed at power users within the company's major client base, which includes the government and education markets as

IN SHORT

Competitive performance and an impressive set of components make the Unitek worth a look.

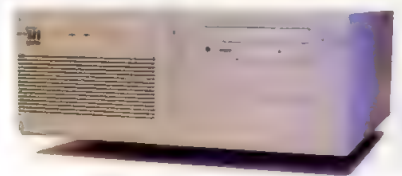
IN SHORT

These high-priced PCs for CAD users don't deliver on mainstream graphics performance.

SERVICE & RELIABILITY

Tri-Star Computer

Reliability	Average
Repair	Average
Tech support	Average
% needing repair	Average



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CIRCLE 201 ON READER SERVICE CARD

well as large aerospace firms.

The Lightning's hardware will not disappoint. Inside its desktop case you'll find a Triton-based Intel motherboard, EDO DRAM, a 1.6GB hard disk, a quad-speed CD-ROM drive, a Diamond Stealth 64 graphics adapter based on S3's Vision968 chip set, and integrated 16-bit sound. On the outside is a 17-inch ViewSonic monitor with built-in speakers, which provide surprisingly good sound.

The Lightning was a competitive performer, posting average scores on our Winstone 95 and Graphics WinMark 95 tests. On our Disk WinMark 95 tests, the unit posted an above-average score.

Unitex backs this system with a one-year parts-and-labor warranty. You can purchase one year of on-site service for \$75.—CV

Unitex Technology Inc., Ontario, CA; 800-944-5650, 909-930-5700; fax, 909-930-5710.

Circle 482 on reader service card

USA Flex

Flex PT-133 Multimedia System

The Flex PT-133 Multimedia System, from USA Flex, offers a great combination of strong Windows performance and a well-rounded features set for a street price of \$4,199. Sold through mail order, this 133-MHz Pentium-based system is aimed primarily toward the small-office market.

There's plenty to satisfy multimedia mavens and home-office users alike inside the PT-133's mini-tower case. This machine came stocked with a Toshiba quad-speed CD-ROM drive, a 16-bit Turtle Beach Tropez wavetable audio card, and a 14.4-Kbps voice modem.

USA Flex rounds out the package with a 17-inch monitor, a 1GB Enhanced IDE hard disk, Altec Lansing speakers with subwoofer, a joystick, and a software bundle that includes business, productivity, and enter-



tainment titles.

On our benchmark tests, the PT-133, utilizing EDO DRAM and 256K of synchronous pipelined-burst external processor cache, garnered an average Winstone 95 score. Its Diamond Stealth 64 graphics accelerator with 2MB of VRAM helped it post an average Graphics WinMark 95 score; its Disk WinMark 95 score was also average.

USA Flex backs the PT-133 with a three-year parts and lifetime labor warranty, as well as 24-hour, 7-day telephone technical support. The first year of on-site service is available for an additional \$49.—CV

USA Flex, Bloomingdale, IL; 800-872-3539, 708-582-6202; fax, 708-351-7204.

Circle 483 on reader service card

Vektron International Inc.

Ultimate Power Station P-133

The Ultimate Power Station P-133, from direct vendor Vektron International, provides a lot of PC for comparatively little money. For \$2,995, this Pentium/133-based system includes a 1.2GB hard disk, a 17-inch monitor, a wavetable audio card, and a quad-speed CD-ROM drive.

This unit is targeted toward high-end corporate customers and its components should please this audience. But its performance, although competitive for the most part, was not outstanding; Windows graphics performance was particularly disappointing.

The mini-tower P-133 had a



IN SHORT

The Vektron has a lot of bang for comparatively few bucks, but performance was middling.

IN SHORT

This unit's features and software bundle will please business and multimedia users alike.

SERVICE & RELIABILITY

USA Flex

Reliability	Average
Repair	Average
Tech support	Average
% needing repair	Worse than average

SuperMicro motherboard—which uses Intel's Triton chip set—EDO DRAM, and pipelined-burst SRAM. The system we received did not have integrated I/O: Here, this meant that one ISA slot was used for the card, and the backplane of another was used for the I/O connectors. But according to Vektron, the units now use a motherboard with integrated I/O.

The P-133 produced average Winstone 95 and Disk WinMark 95 scores. But on our Graphics WinMark 95 tests, this system—using a DRAM-based STB Powergraph 64 graphics accelerator with S3's Trio 64 chip set—could not keep up with this roundup's graphics leaders, most of which had Diamond Stealth graphics accelerators based on S3's new Vision968 chip set.—CV

Vektron International Inc., Grand Prairie, TX; 800-725-0026, 214-606-0280; fax, 214-606-1278.

Circle 484 on reader service card

Zenith Data Systems

Z-Station GT

Zenith Data Systems' Pentium/120-based Z-Station GT shares many features with its Editors' Choice-winning predecessor, the Pentium/90-based Z-Station EX (*PC Magazine*, December 6, 1994): It's a well-integrated, network-



ready PC backed by a good warranty. This time, however, the Z-Station did not perform well. And with a street price of \$5,100, it is one of the most expensive systems in this roundup.

Some of the unit's integrated and dated components stunted its performance. Its Triton-based motherboard has a memory subsystem composed of half fast-page mode DRAM and half EDO DRAM (not standard practice), so it met the

IN SHORT

A high price and poor performance detract from this network-ready slimline PC.

SERVICE & RELIABILITY

Zenith Data Systems

Reliability	Worse than average
Repair	Worse than average
Tech support	Worse than average
% needing repair	Average

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The two of us, changing the world — just like old times, Bill.



CIRCLE 804 ON READER SERVICE CARD

Quarterdeck

lowest common denominator by treating all the memory as slower, standard DRAM. In order to conserve PCI slots, the slimline unit has integrated graphics; however, this graphics subsystem is based on S3's budget-oriented Trio 64 chip, which uses DRAM. These factors contributed to the unit's below-average Winstone 95 and Graphics WinMark 95 scores and average Disk WinMark 95 score.

On the positive side, the rest of the Z-Station's components are great and include a Toshiba quad-speed CD-ROM drive, a Creative Labs 16-bit sound card, a 17-inch monitor, a 1.2GB hard disk, and an integrated Ethernet controller.

The Z-Station is backed by a three-year warranty that covers parts and labor. One year of on-site service and 24-hour, 7-day telephone technical support are included.—CV

Zenith Data Systems, Buffalo Grove, IL; 800-533-0331, 708-808-5000; fax, 800-472-7211.

Circle 485 on reader service card

Zenon Technology Inc.

Dream Media P5-120

Dream Media P5-133

The \$3,249 Dream Media P5-133 and the \$2,949 Dream Media P5-120, from Zenon Technology, are both aimed at the high-end CAD market. You may be better off saving the extra \$300 and going with the Pentium/120-based system, however: The two units have near-identical configurations, and the P5-120 was the highest-scoring Pentium/120 on our Winstone 95 tests.

The P5-133's Winstone score was average for its processor class, as was its Graphics WinMark 95 score. Its Disk WinMark 95 score was above average, however. The

IN SHORT

Both PCs offer strong performance for CAD, but the P120 emerges as the better value.

P5-120 fared better in relative terms; in addition to this unit's first-place Winstone score, its Graphics WinMark and Disk WinMark results were both above average for its processor class.

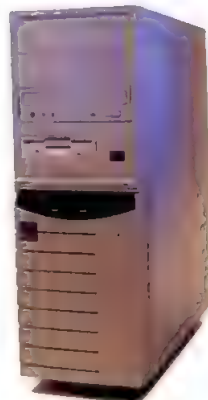
Both systems feature EDO DRAM,

256K of synchronous pipelined-burst external processor cache, and a 1GB hard disk. They each use the Diamond Stealth 64 graphics accelerator with an S3 Vision 968 chip set and 2MB VRAM, and each has a 16-bit Creative Labs sound card (a Sound Blaster AWE32 on the P5-133 and a Sound Blaster 16 AWE on the P5-120). The units come with modems as well: The P5-133 has a 28.8-/14.4-Kbps data/fax modem, and the P5-120 includes a 14.4-Kbps fax modem.

The Dream Media team is backed by a one-year parts and lifetime labor warranty. You can purchase one year of on-site service for \$50.—MEB □

Zenon Technology Inc., City of Industry, CA; 800-899-6119, 818-935-1828; fax, 818-935-1826.

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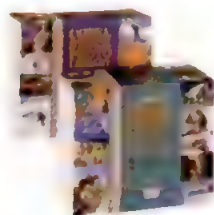
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PC Tech

THE DEFINITIVE GUIDE TO PC TECHNOLOGIES & TOOLS

Using PC Databases As Query Tools

Access and Paradox have learned a few tricks from dedicated client/server query tools.

By Sal Ricciardi

Getting answers to complex questions is one of the biggest reasons we invest in the time and expense of using a database management system. Who's our best customer? What do our sales look like by region? What's our best-selling product by quarter? Clear, accurate, and up-to-date answers to questions like these are a cornerstone of managing any complex business. So where do these answers come from?

Several types of graphical products exist today to help you query your database. Of these, dedicated front-end query and reporting tools such as Borland ReportSmith for Windows and Intersolv Q+E are probably the best-known in corporate environments. Such tools are typically client applications designed to query data from corporate databases that reside on servers. These specialized products concentrate on the retrieval and presentation of information and may offer complex features for drill-down analysis or reporting. Typically, they have no built-in data management capabilities; many also require you to have a detailed knowledge of your own database and the workings of relational databases in general.

A newly emerging subset of these front-end tools, intelligent query tools, try to let end users build queries using more intuitive "business objects" that an administrator has predefined out of elements in the underlying database. In general, intelligent tools are less mature than their mainstream rivals and require substantial administrator



IN THIS SECTION



TUTOR Jeff Prorise asks what the optimal FILES setting for your PC is and provides a mini-utility to find the answer for the DOS applications you use. With some extra care, you can also use it to check the FILES setting needed by DOS programs run under Windows. *page 245*



INSIDE WINDOWS 95 How many Window objects can you create in Windows 95? Is it possible to crash OS/2 Warp? Here is a look inside the utilities we used to test the crashability and capacity of Windows 3.1x, Windows 95, OS/2 Warp, and Windows NT Workstation for the issue's cover story. *page 251*



POWER PROGRAMMING Ray Duncan generously lets readers strike back with their insights, questions, and corrections in response to his past columns on WinHelp and the World-Wide Web. Topics range from discontinued Microsoft tools to virtual white-water rafting. *page 257*



INTERNET WORKING Did SATAN and Courtney really bring down the Internet? Now that the furor is dying down, it's clear that this duo of Internet security tools is on your side. Used wisely, they can help you reach the high security levels you should have. *page 265*



UTILITIES Practice safe setups. Neil J. Rubenking's InCtrl2 helps you perform reliable uninstalls by tracking what's going on when presumptuous Windows software installs itself all over your hard disk. This highly enhanced version of his ever-popular InCtrl utility incorporates a wizard-like interface and will even survive a reboot. *page 269*

ALSO IN THIS ISSUE PC Solutions' User-to-User section offers a batch file that gives you a pithy report on how many files are taking up how much disk space on your hard disk. The Ask Our Advisors section shows how to swap your A: and B: drive assignments and offers a technique for slimming bloated PageMaker files. *page 285*

Databases as Query Tools

involvement (for a detailed look at dedicated SQL query and reporting tools of both types, see "Straight Answers, Limited Risks," *PC Magazine*, June 13, 1995).

PC DATABASES

PC-based database management systems offer an alternative. These let you construct local or remote queries and produce reports; they differ from dedicated query tools in that they are full-fledged database management systems, not just query or reporting tools. While they are primarily intended for working with local data, they can also offer sophisticated connectivity to server-based SQL data. But here too you'll need a fair amount of database savvy to construct a query that produces the right result. Fortunately, the products are getting better at making this process easier. Many a corporate user already owns a PC database as part of an application suite, and thus it is worth investigating the power of such databases as client/server query tools.

In this article we take a look at the two leading PC-based database management systems, Microsoft Access 2.0 and Borland Paradox for Windows 5.0, with an eye on how you use them to query a local or remote database. We'll look in detail at each product's query interface and the steps needed to connect to corporate data.

QUERIES AND JOINS

A query is a request for information from your database. You use queries to choose columns and rows for display, to sort rows, and to perform calculations; you can even use them as the basis for making changes to the information in your database. But most often you use a query to ask a question.

To ask a question, you must formulate your query in language that the database management system can understand. Unless you have a database administrator set things up for you ahead of time, this means knowing at least what database and what tables hold the information required to get the answer. That's because a relational database divides information into many subject-based tables in order to minimize data duplication. You then provide your database management system with the means to reconnect the data by placing common columns into related tables.

For example, you might have a SalesOrder table and a LineItem table linked by Order number. To construct a query to return Sales by Month, you must tell your product to *join* the SalesOrder table and the LineItem table on the Order number. The SalesOrder table contains the sale date. The LineItem table

contains the items sold and the prices paid. The query facility matches rows based on the Order number, calculates the sales for each item based on quantity and price, and sorts and groups the results by month. Joining tables might seem like arcane science, but it's required for all but the most simple queries. Thus, constructing a query requires knowledge about the design and structure of your database and, in particular, the relationships between tables.

Both Access and Paradox for Windows place the knowledge requirement squarely on your shoulders, though they differ in how they facilitate and support the creation of table relationships and how they use that information. Access lets you

JOINS between tables are indicated graphically. Here is a one-to-many join on Customer ID.

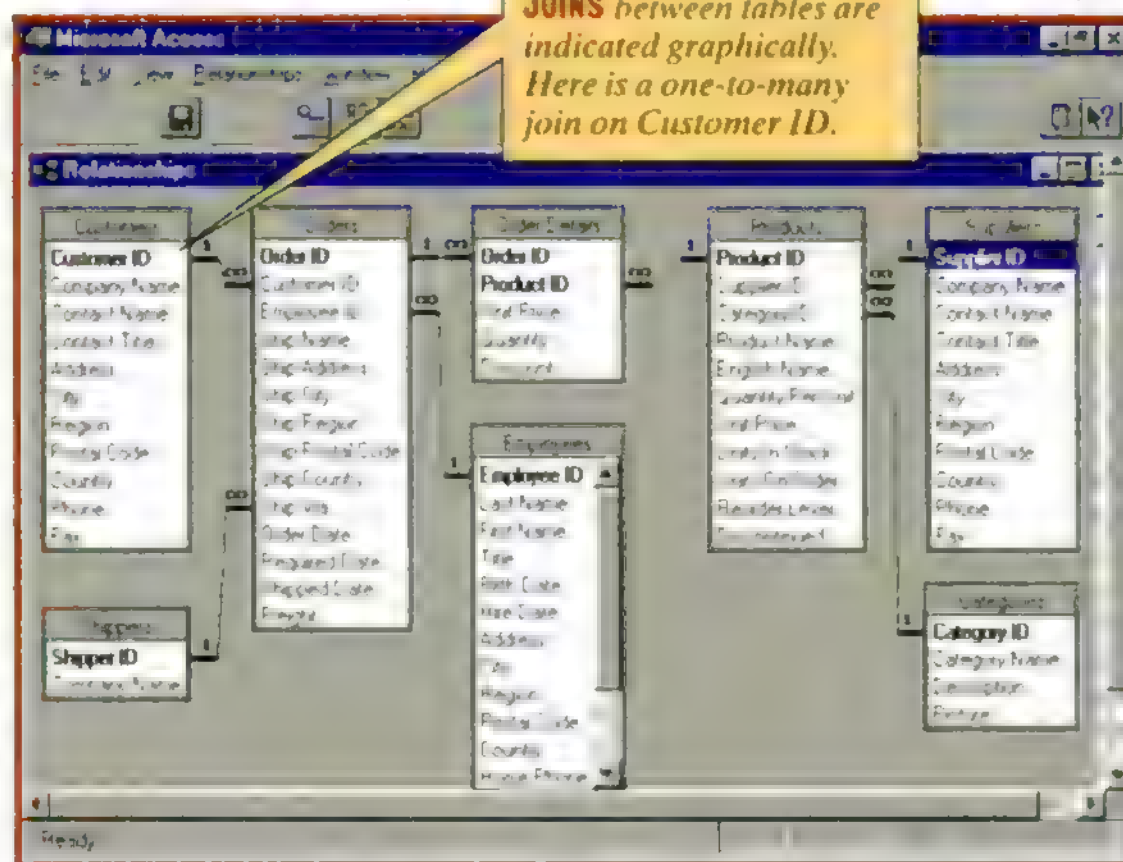


FIGURE 1: Access's Relationships window, where you define table relationships.

group your tables, queries, reports, macros, forms, and any Access Basic code modules into a central database container. You can then define your table relationships once, and the product will use that information wherever possible (see Figure 1). For example, when you add tables to a query, Access automatically supplies the default join condition, linking the tables based on your saved table relationships.

Paradox for Windows has no central database container, so there's no real concept of a database per se. But you can create an external data model that defines table relationships and then choose that data model as the basis for a query (see Figure 2). Paradox then supplies tables and joins based on the data model, but it includes all the data model tables by default instead of letting you select which ones to include.

SQL AND QBE

Methods for specifying a query have improved over time. Traditionally you would have used SQL (structured query language). Developed in the mid-seventies as a data-manipulation language for a research project at

IBM, SQL became the de facto standard language for use with relational databases by the mid-eighties. But like any other language, SQL takes time to learn, and your success depends on your knowledge of the relational database fundamentals on which it's based. Still, SQL is quite powerful and remains the standard language for querying server databases. Today's PC database management systems recognize the importance of SQL, and indeed both Access and Paradox for Windows support SQL out of the box.

In the late seventies, IBM Research developed a new query technique called QBE (query by example), designed to be easier for nonspecialist users. QBE is an example-based technique, so called because you supply query details by filling in empty table skeletons with example values. For instance, to locate rows where the state value is New York, you would move to the State column and enter NY. To join tables, you supply an example element in each table. For example, to join the SalesOrder and LineItem tables, you'd place JOIN1 in the order number column in the SalesOrder skeleton and a matching JOIN1 in the order number column in the LineItem skeleton. To find salaries greater than \$40,000, you'd enter > 40000 into the appropriate column in the skeleton. The basic idea is to make the dialogue easy to learn and reduce any reliance on keywords or language syntax.

Most database management systems and query products offer some type of fill-in-the-blanks query-by-example technique, though these are not necessarily based on IBM's formal QBE syntax. For instance, Access uses a more recent technique called *graphical query by example* (GQBE), so named because joins are specified graphically instead of with example elements, and because it uses modern GUI techniques like drag-and-drop. Paradox for Windows, on the other hand, uses a QBE method that closely resembles the original QBE. This may prove to be an advantage for those familiar with the IBM approach. Other PC database products—Lotus Approach 3.0, for instance—use an example-based technique called *query by form*, where users fill in an empty form to supply query information.

There's a certain amount of synergy between the QBE interfaces used in Access and Paradox for Windows and the SQL language. Both products, for example, generate SQL statements from your QBE input to retrieve data from a server. And Access can go the other way too, so you can make changes to the

generated SQL and have them reflected back into Access's QBE grid.

PARADOX: TRADITIONAL QBE

Paradox for Windows' query-by-example interface closely resembles the original QBE interface. To create a query, you choose File | New | Query and then select tables for the query. You have the option of choosing a data model, in which case Paradox supplies the tables from the data model. Each table becomes an empty skeleton on the query design surface (see Figure 3).

To select columns for inclusion in the query result, you place a graphical check mark in each column. The default check includes only unique values in the result. Other types of check marks let you include duplicate values, sort in descending order, or group rows based on field values.

To supply match criteria, you simply type the example values in the appropriate columns. You can use special operators such as NOT, BLANK, LIKE, or wildcard characters to refine your search and comparison operators to specify a range of values. You can also express AND and OR conditions, the former by using a comma to separate sample values and the latter by using the OR operator or an additional line. You also have a range of operators available for performing calculations or aggregate computations.

Paradox's QBE supports *example elements*, symbols that behave somewhat like variables.

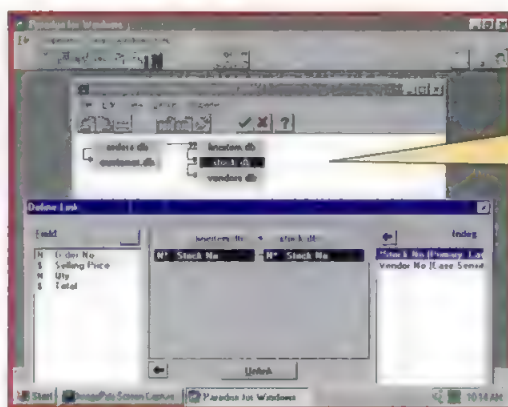


FIGURE 2: Paradox for Windows' Data Model Designer.

You use an example element to represent the generic value of a certain field. You can then use the example element in calculations or selection conditions, or to join tables. In Paradox queries, you join tables by placing them on the query design surface and specifying the same example element in matching columns in each table. You can do this graphically by choosing the Join Tables toolbar icon and then clicking first on the column in the first table and then on the column in the second table. Or you can type in the matching example elements using the keyboard.

ACCESS'S GRAPHICAL QUERY BY EXAMPLE

Access's graphical query-by-example interface uses a much more point-and-click, drag-and-drop approach. To create a query, you se-

lect the Query tab in your database container and then choose New. You can then create a new query using a Wizard or using the Query window. When you select the Query window, you can choose tables or existing queries to add to the Query window.

You'll see your tables shown in the upper part of the query window (see Figure 4). Access will automatically supply the default join conditions between your tables if you've set up your table relationships ahead of time. Even if you haven't, Access may create a join for you if the two tables have matching fields. Otherwise, you can join tables by dragging a line between the appropriate fields.

To select the columns to include in the query, you drag fields from the field list in the upper portion of the Query window to the Field row in the QBE grid in the window's lower portion. That way, you see only the fields you need for your query in the QBE grid. You can choose a sort order for a column by clicking in the Sort cell and choosing from the resulting drop-down list.

You supply match criteria by entering example values in the Criteria section. As with Paradox, you have a range of comparison operators, special functions, and wildcard characters for refining your search criteria. To combine more than one condition (a logical AND) within a single field, you use the AND operator. Multiple conditions on the same criteria row are automatically combined with AND. To specify an

Microsoft Access 95: New Ways to Query

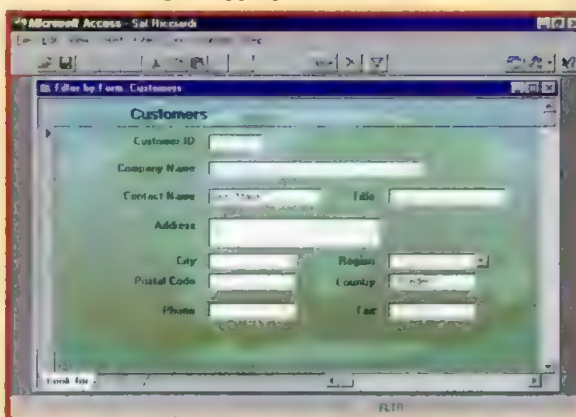
By Sal Ricciardi

No one query technique is appropriate for all users at all times. In fact, a great product should support a variety of different ways to query your data. Judging from an early beta of the upcoming Microsoft Access 95, Microsoft agrees.

For starters, Access 95 will support Filter By Form. With Filter By Form, you can click on a toolbar button and your form will be turned into an empty view in which you can enter selection criteria. Just fill in the blanks and click on a toolbar button and Access applies the filter. You specify the values you're searching for by typing them in or selecting from picklists. You can also call up Expression Builder for help with creating the selection criteria. Filter By Form promises great simplification of many basic

queries, and it works with datasheets too.

The new release will also support Filter By Selection. With this, you can specify the value you're searching for by highlighting it in a form or datasheet and then clicking the appropriate toolbar button.



EASY QUERIES: Access 95's new Filter By Form capability will let you fill in a blank form to look for matching values.

Once Access applies the filter, you can then further narrow the set of records you're working with by highlighting another value and clicking the toolbar button again.

A new Query Wizard will let you choose

the fields you want in your query result and have Access figure out what tables to join. A Performance Analyzer Wizard will analyze your tables and recommend changes to improve performance, such as adding indexes or altering data types. Depending on the changes, your query performance could improve substantially. You'll also be able to sort your query results quickly by right-clicking Sort Descending or Sort Ascending, or by clicking buttons on the toolbar. And you'll be able to save filters with Tables, Forms, and Reports so that they will be applied automatically the next time.

OR condition, you combine criteria within a single field using the OR operator or specify each condition on a separate criteria row. If you'd rather not type in your criteria directly, you can call up Access Expression Builder and build your criteria by selecting from lists of fields, functions, constants, operators, and common expressions. Access supplies a full complement of operators and functions for creating calculations or summary computations on your data.

FILTERS, FINDS, WIZARDS, CROSSTABS

Both Access and Paradox for Windows supplement their full-fledged query interfaces with simpler methods for quickly locating information. For instance, both support a feature called a *filter*. A filter is like a simple query, to be used when you don't want to go to the trouble of creating a genuine saved query but need to locate a row quickly, perhaps just once. Filters are best used for temporarily filtering the set of rows you're already viewing. The disadvantage of filters is that they have more limitations than the full-fledged query interfaces—for example, you can't use a filter to calculate totals.

When working with a table, you often need to look quickly for a certain value in a column or row. For example, you might need to find the name "Smagurkey" in the Last Name column. Access and Paradox for Windows both provide a feature for this type of ad-hoc lookup. In Access it's called Find, and in Paradox it's called Locate Values. Both let you decide to search for a value only in a specific column or anywhere in a row.

In addition to queries, filters, and the find menu item, Access ships with a set of query wizards designed to walk you through the steps required to create certain types of queries. There are four wizards: one for creating crosstab queries, one for finding duplicate rows in a table or query, one for finding records in one table that are unmatched in another, and an archive wizard that copies records from an existing table into a new one and then optionally deletes the rows in the original table. Of these four, we were especially impressed with the Crosstab Wizard.

A crosstab query summarizes information in a spreadsheet-like row-and-column format. For example, we used a crosstab query with our sample database to summarize Sales by Product and Year. To do so, we first created a regular select query using Access's query designer to retrieve and summarize product sales

by year. We then used the Crosstab Wizard to generate a crosstab query using our original query as input. In response to the Wizard's prompts, we chose Productname as the row heading, Year as the column heading, and Sum(Sales) as the summary value. Access then generated the query and produced the results. The whole process took about 10 minutes.

Access's support for crosstab queries is implemented through the Transform statement, an extension to Access's SQL implementation. Paradox for Windows currently has no built-in support for crosstab queries and includes only one query assistant, called a Coach, which takes you through the creation of a simple single-table query.

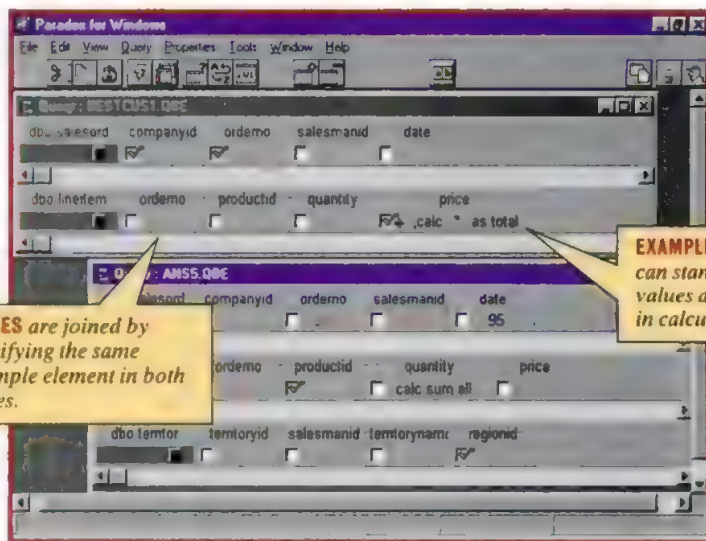


FIGURE 3: Paradox for Windows' query-by-example interface.

CLIENT/SERVER QUERIES

It used to be that getting a PC database to access any data on a server required a major coding effort. Not anymore. These days, server access is demanded, and today's products are becoming as good at handling remote data as they are at handling local data. Access and Paradox for Windows are no exception. Neither product had difficulty accessing or retrieving information from our test Microsoft SQL Server 4.21a database; Access used an ODBC connection, and Paradox used one of Borland's optional SQL Link drivers.

To connect to server data using Access, you must first install the appropriate ODBC drivers for your server database (Access ships with drivers for Microsoft SQL Server and Sybase SQL Server). Next, you use the ODBC Administrator application to set up a data source for each database you need to access. For example, we set up a pcmagsales data source for accessing our pcmagsales test database on Microsoft SQL Server. The data source stores information about the remote database you want to access along with information about accessing the server on which the database resides, such as the serv-

er name, for example.

Once you have the appropriate data source set up, you can create a new Access database and attach the remote SQL tables to it. When you choose to attach a SQL database table, Access lets you select one of the data sources you've defined. Then you'll be asked for your server ID and password, and Access will connect to the server and present you with a list of tables. Once you attach a SQL table, you can use it within Access just like you would a local table. The only difference is that the data continues to be stored externally in your SQL database.

When creating queries that access remote ODBC data sources, Access will cancel the query if the server doesn't respond within a certain amount of time. Each query has its own time-out value property. You'll want to increase it if you start experiencing frequent ODBC time-out error messages.

To access server data with Paradox for Windows, you first install the appropriate SQL Links driver for your SQL database. Borland offers drivers for Informix, InterBase, Microsoft, Oracle, and Sybase SQL

databases. Once you install the driver, you use Paradox to create an alias for your server database, a process that's similar to creating an ODBC data source. You supply the database name, server name, driver type, login ID, and so on. Then, when you want to open a remote table, you choose the alias name in the Open

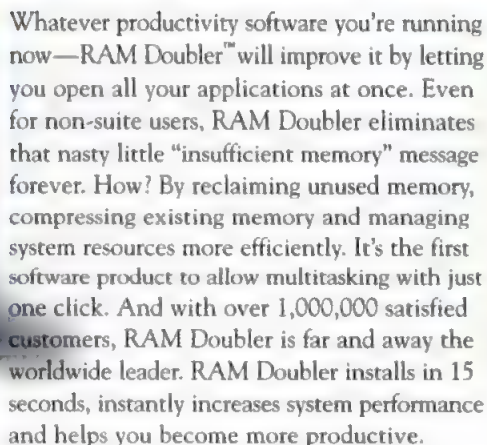
dialog, and Paradox displays a server login dialog where you supply your server password. Like Access, Paradox will cancel a remote query if the server doesn't respond within a certain amount of time.

Before you can work with server data using either product, you need to have the appropriate permissions for your server database. You'll need to use the appropriate administrator application for your particular server or have your database administrator set up the appropriate permissions for you.

Access automatically generates a live, updatable query result wherever possible. This means you can make changes to the query result and those changes will automatically be propagated back to the original tables, even with many multitable joins. This can be a tremendous convenience. When querying remote data, Access cannot send updates back to a server table unless the table has a Unique index. This makes sense, since Access must be able to uniquely identify every row it needs to update. Paradox for Windows' support for live query views is limited to single-table queries; you must choose Live Query View in the Answer Option dialog box.



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HOW THEY FARED

We created and executed a variety of test queries of local and remote data using both products to see how each held up under scrutiny. Our test database consisted of nine tables, and the queries included questions like "What are our top-selling products by region?" and "Who are our best customers?" Most of the queries involved multitable joins. To sum up, both products were able to handle the full range of queries we tried, but with different degrees of finesse. We were able to construct and execute the queries with considerable ease using Access's QBE interface. Using Paradox for Windows, however, many of the queries required multiple steps: first getting an intermediate result to an answer table, then querying the answer table to get the next step, and so on. You could chain the steps together using code, but in general we found the Paradox QBE interface more difficult to learn and use.

Access's technique of grouping all database objects and tables into a container and then specifying a single master set of table relation-

ships makes a lot of sense and cuts down on the amount of work involved when creating queries. For example, you don't need to wade through directories looking for the tables to place in your query; Access lets you choose from those in your database container. This centralized view of a database and its components is the right approach and one we'd like to see other vendors adopt.

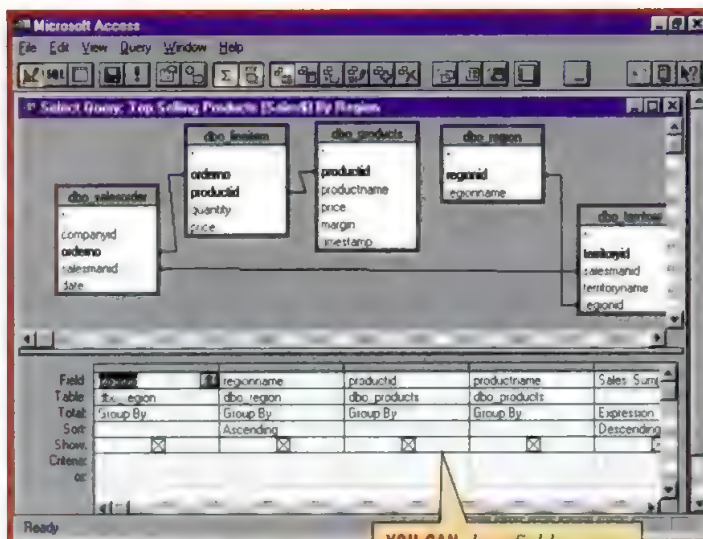


FIGURE 4: Access's QBE interface.

The Wizards in Access truly add value, especially the Crosstab Wizard. Microsoft's extensions to standard SQL, including Transform for crosstab queries and Top n for limiting the number of rows returned, make otherwise difficult tasks easy to perform. If you've been schooled in traditional QBE, you'll find the Paradox for Windows query technique to be very familiar territory. But if you're starting from scratch, you may find Microsoft Access's QBE at least as capable and easier to master. □

Borland Paradox for Windows 5.0. Estimated street price: \$350. Recommended system configuration: 486-based PC with 8MB RAM, Microsoft Windows 3.1 or later. Borland International, Scotts Valley, CA 95066; 800-233-2444.

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Microsoft Access 2.0. Estimated street price: \$339. Recommended system configuration: 386-based PC or better with 8MB RAM, Microsoft Windows 3.1 or later. Microsoft Corp., Redmond, WA 98052; 800-426-9400.

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PC Tech/Tutor

By Jeff Prosis

How Many FILES Do You Need?

The FILES setting in your CONFIG.SYS file could be costing you precious memory.

Quick: What is the best FILES setting for your PC? If you don't know the answer, you're not alone. FILES specifies the maximum number of files that the operating system allows to be open simultaneously. Most users think little about it unless problems occur. "Problems" usually means error messages warning that not enough file handles are available or that an application can't open a file. The bad news is that if you're not getting error messages, FILES may be set too high and you may be letting memory go to waste. If you run only Windows applications, the FILES setting is of little consequence, but most Windows users still run some DOS programs.

DOS stores information regarding open files in a data structure known as the *system file table*, or SFT. The SFT is structured so that it doesn't have to occupy a single, contiguous block of memory; indeed, DOS normally fragments the SFT into two or more blocks (see Figure 1). This turns out to be quite convenient, because it allows Windows to extend the SFT by adding extra blocks. At start-up, DOS consults the FILES statement in CONFIG.SYS to determine how many SFT entries to create and thus how much memory to allocate for the SFT. The number of open files cannot exceed the number of entries in the SFT. A setting of FILES=20 enables up to 17 files to be open at once. (DOS treats the CON, PRN, and AUX device drivers as files and leaves them open all the time, so the actual limit is three less than the number specified by FILES.) By default, individual applications are limited to 15 open files, but a simple function can remove this limitation.

FILES=20 is plenty for most applications, but some—notably, large relational database programs—require higher settings.

Running multiple DOS applications in a multitasking environment such as Windows frequently exacerbates the problem. If several applications have files open concurrently, the SFT must be large enough to accommodate them all.

You can all but eliminate the restrictions that DOS places on concurrently open files by setting FILES equal to 255, the maximum permitted. But that's wasteful, because each SFT entry, whether used or not, requires from 40 to 59 bytes of memory, depending on the DOS version. A setting of FILES=255 uses more than 14K of conventional memory in DOS 4.0 and higher, while FILES=20 uses less than 1K. Clearly, it is advantageous

to use the lowest FILES setting necessary. But, given that this setting varies depending on what applications you run and how you run them, how do you figure out what it should be?

In the past, users had to resort to lengthy trial and error to determine the optimum FILES setting. But there is a better solution. Using DEBUG, you can build a small utility that examines the system file table and reports back the maximum number of files open at any time, which in turn reveals the minimum FILES setting required to get the job done. This is valuable information if you wish to optimize memory usage by paring the system file table down to size.

THE OPTIMUM FILES SETTING

The first step in determining the optimum FILES setting for your PC is to start your favorite text editor (DOS's EDIT command or the Windows Notepad will do nicely) and type either of the DEBUG scripts shown in Figures 2 and 3. For the programming-cur-

ious, Figure 3 shows the assembly language instructions used to create the program. Figure 2 provides a shorter, hexadecimal version that's faster to type in. When you're finished, save your work in a text file named FILECHK.SCR. Then exit the text editor and type

```
DEBUG <FILECHK.SCR
```

at the DOS prompt to execute the script. This will create a small command line utility named FILECHK.COM in the current directory. CompuServe users can save typing time by downloading FILECHK.COM from Library 3 of PC MagNet's Utilities/Tips Forum as FLCHK.ZIP.

Step two is to edit your CONFIG.SYS file and set FILES=255, and then reboot. This will set the size of the system file table to the maximum possible and give DOS plenty of room in which to operate.

How you proceed from here depends on whether you run DOS or Windows. For a DOS-only environment, the procedure is simple. Run all the applications that you normally use

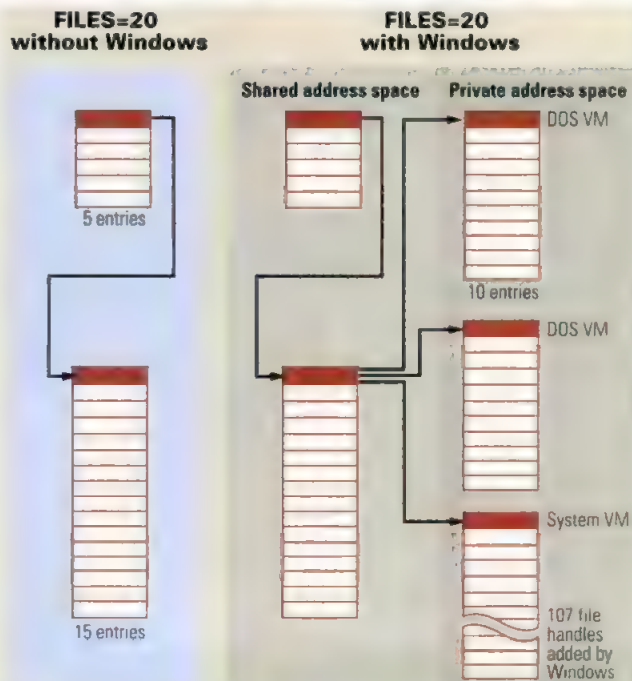


FIGURE 1: Booting with FILES=20 produces two blocks in the system file table (SFT), the first containing entries for 5 open files and the second for 15. A header at the beginning of each block contains the address of the next one. Windows makes up to 127 file handles available to Windows applications by adding a third block that's private to the system virtual machine (VM). Windows also adds the number of entries specified by SYSTEM.INI's PerVMFiles setting to each DOS VM (the default is 10).

one after another, in each case exercising the application the way you would in the course of a normal work session. When you're done, type

```
FILECHK
```

to get a report on system file table usage. The output will look something like this:

```
Number of SFT entries: 255
```

```
Maximum number of entries used: 16
```

Here we learn that the current FILES setting is 255, and that thus far no more than 16 files have been open at the same time. Knowing this, you can change FILES=255 to FILES=20 to optimize the size of the system file table. If FILES was set to, say, 60 before, then you just saved yourself more than 2K of memory. It's a good idea to set FILES to a number slightly higher than the maximum-entries value reported by FILECHK to leave yourself a little breathing room in case more open files are needed later.

If you're a Windows user, the procedure is slightly different. After setting FILES=255 in CONFIG.SYS, make sure 32-bit file access is disabled if you use Windows for Workgroups, Version 3.11. When 32-bit file access is enabled, Windows bypasses the DOS file system and thus prevents FILECHK from working properly. You can find the 32-bit file access check box by starting Control Panel, double-clicking the 386 Enhanced icon, clicking the Virtual Memory button, and then clicking the Change button. Disable 32-bit file access and restart Windows so the change will take effect. It's okay to leave 32-bit disk access enabled.

The next step is to start one or more DOS sessions and run the DOS apps that you normally use inside Windows. If you typically have several DOS apps going at once, run them concurrently here too. Do not run any Windows apps during this test, because doing so could skew the results. Afterward, close all the DOS sessions but one and run FILECHK to see how many files were open concurrently. Add 4 or 5 to this number and make that your new FILES setting. The maximum-entries-used value reported by FILECHK will probably be higher for Windows, because Windows keeps about a dozen files open itself. Before you reboot your system with the new setting, you may reenable 32-bit file access (if applicable) to give file system performance an extra boost.

Whether you're a DOS or Windows user, your FILES setting should now be more in tune with the way you work. If you subsequently receive error messages about too few file handles or the inability to open a file, bump FILES up by 5 or 10 and see if that eliminates the problem.

```
N FILECHK.COM
E 0100 EB 5E 20 00 3B 00 00 00
E 0108 00 00 55 6E 73 75 70 70
E 0110 6F 72 74 65 64 20 44 4F
E 0118 53 20 76 65 72 73 69 6F
E 0120 6E 0D 0A 24 4E 75 6D 62
E 0128 65 72 20 6F 66 20 53 46
E 0130 54 20 65 6E 74 72 69 65
E 0138 73 3A 20 24 4D 61 78 69
E 0140 6D 75 6D 20 6E 75 6D 62
E 0148 65 72 20 6F 66 20 65 6E
E 0150 74 72 69 65 73 20 75 73
E 0158 65 64 3A 20 24 0D 0A 24
E 0160 B4 30 CD 21 BA 0A 01 3C
E 0168 06 77 35 3C 02 72 31 3C
E 0170 04 73 36 3C 02 75 0E C7
E 0178 06 02 01 04 00 C7 06 04
E 0180 01 28 00 EB 24 80 FC 00
E 0188 75 0E C7 06 02 01 21 00
E 0190 C7 06 04 01 38 00 EB 11
E 0198 C7 06 04 01 35 00 EB 09
E 01A0 B4 09 CD 21 B8 01 4C CD
E 01A8 21 B4 52 CD 21 26 8B 7F
E 01B0 04 26 8E 47 06 26 8B 45
E 01B8 04 01 06 06 01 E8 3F 00
E 01C0 01 06 08 01 26 8B 1D 26
E 01C8 8E 45 02 8B FB 83 FF FF
E 01D0 75 E3 B4 09 BA 24 01 CD
E 01D8 21 A1 06 01 E8 3D 00 B4
E 01E0 09 BA 5D 01 CD 21 B4 09
E 01E8 BA 3C 01 CD 21 A1 08 01
E 01F0 E8 29 00 B4 09 BA 5D 01
E 01F8 CD 21 B8 00 4C CD 21 57
E 0200 26 8B 4D 04 03 3E 02 01
E 0208 83 C7 06 33 C0 26 83 3D
E 0210 00 74 01 40 03 3E 04 01
E 0218 E2 F3 5F C3 BB 0A 00 33
E 0220 C9 41 33 D2 F7 F3 52 0B
E 0228 C0 75 F6 5A 80 C2 30 B4
E 0230 02 CD 21 E2 F6 C3
RCX
136
W
Q
```



FIGURE 2: This hexadecimal DEBUG script creates the miniutility FILECHK.COM.

HOW FILECHK WORKS

FILECHK works by examining each entry in the system file table to determine whether it has ever been used. One of the fields contained in an SFT entry is the name of the open file. All SFT fields are initialized with zeros, so if an SFT entry's filename field holds any nonzero values, then that entry has been used at one time or another. When a file is opened, DOS scans the SFT from beginning to end and allocates the first entry that isn't currently in use. And when a file is closed, the corresponding SFT entry is freed, but the filename field still contains the name of the last program to use the entry. It follows that the number of SFT entries with nonzero data in the

filename field accurately reflects the maximum number of files that were open at any one time.

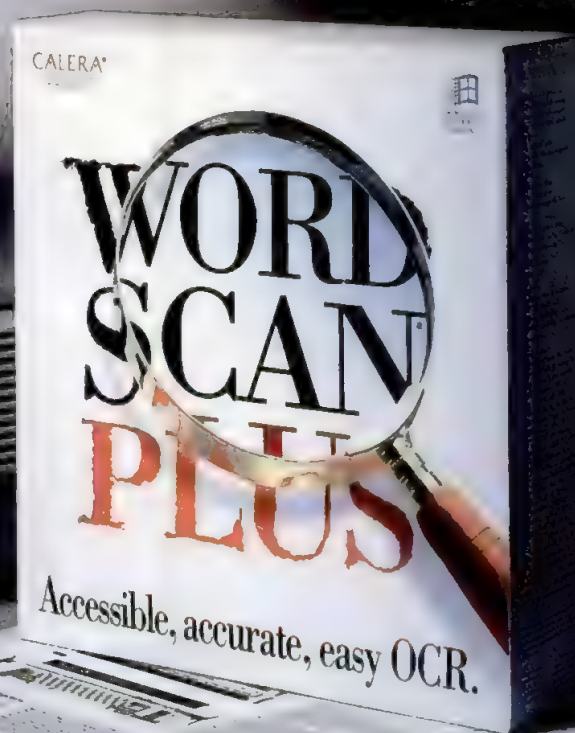
When you're not running Windows, this method works like a champ. There is only one system file table, and every application uses it. If the SFT has 20 entries and 12 of them have been used, then at one time or another 12 files were open concurrently.

The presence of Windows complicates matters just a bit. Windows plays some tricks with the system file table, with the result that things aren't always what they seem. Each time a virtual machine (VM) is started, Windows lengthens the system file table by adding some entries of its own. The extra entries are private to each VM, so data written to them in one VM is not visible in other VMs. In the system VM (the VM in which Windows applications run), the system file table is extended to the equivalent of FILES=100 or FILES=127, depending on how much memory is available. In DOS VMs, the system file table is extended by the number of entries specified by the PerVMFiles statement in the [386Enh] section of SYSTEM.INI, or by 10 if no such statement exists. Thus, if you boot the system with a FILES=30 statement in CONFIG.SYS and run FILECHK in a DOS box, FILECHK will probably report that 40 entries are in the SFT. The extra ten entries are the private ones added by Windows. If you could run a protected-mode version of FILECHK in the system VM, it would report the length of the SFT as 100 or more.

SFT entries that are private rather than shared by all VMs are bad news for FILECHK, because it can report only the private entries for the VM in which you run it. Suppose you boot up with a setting of FILES=30 and then start Windows. In the system VM, Windows extends the SFT with 97 private entries to increase the total to 127. In each DOS VM, Windows adds 10 private SFT entries to take the total to 40. Now suppose you run a DOS application that increases the open file count to 38. FILECHK will report 38 opened files if it is executed in the VM that hosted the DOS app, but because only the first 30 SFT entries are global to all the VMs, FILECHK reports only 30 opened files if it is executed in another DOS VM. Ideally, it should report the same value no matter what VM you run it in.

That is why it's important to set FILES equal to 255 before performing this test. In Windows, FILES=255 has the effect of making the system file table a global resource shared among all programs. Even Windows can't extend the SFT beyond 255 entries, so FILES=255 ensures that no VM-specific entries will be added. Now any modification made to the SFT in one VM will be clearly visible in the others, and FILECHK will report

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 - ✓ Microsoft Office compatible.
 - ✓ Highly accurate.
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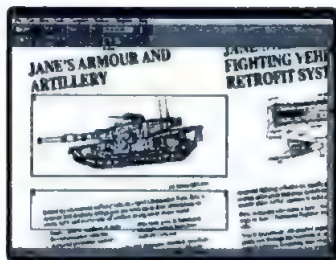


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consistent results no matter what VM it's run in. A side effect of setting FILES=255 is that files opened by Windows applications running in the system VM will be visible in DOS VMs too. That's why it is wise not to run any Windows apps while testing for the optimum FILES setting. Windows makes sure Windows apps have plenty of file handles by ex-

tending the SFT in the system VM, so there's no need to increase the FILES setting to accommodate Windows apps. Windows normally uses upper rather than conventional memory for SFT extensions, so the extra entries cost you nothing in terms of the largest executable program size.

Disabling 32-bit file access prior to testing

for the optimum FILES setting is necessary because the 32-bit file access driver bypasses the SFT. If an application opens 100 files with 32-bit file access enabled, not one of those files will show up in the system file table and FILECHK will report erroneous results. Does that mean there is no limit on the number of files that can be open when 32-bit file access is

```

A 0100
JMP 0160          ;Jump to code start
DW 20,38,00,00
DB "Unsupported DOS version",0D,0A,"$"
DB "Number of SFT entries: $"
DB "Maximum number of entries used: $"
DB 0D,0A,"$"
MOV AH,30         ;Get the DOS version
INT 21
MOV DX,010A
CMP AL,06         ;Error if the version
JA 01A0           ;is less than 2 or greater
CMP AL,02         ;than 6
JB 01A0
CMP AL,04         ;Jump ahead if it's 4.0 or
JNB 01A9          ;higher
CMP AL,02         ;Make some adjustments if
JNZ 0185          ;it's version 2.0
MOV WORD PTR [0102],0004
MOV WORD PTR [0104],0028
JMP 01A9          ;Done (2.0)
CMP AH,00         ;Make some adjustments if
JNZ 0198          ;it's version 3.0
MOV WORD PTR [0102],0021
MOV WORD PTR [0104],0038
JMP 01A9          ;Done (3.0)
MOV WORD PTR [0104],0035 ;Adjust for versions 3.1-
JMP 01A9          ;3.3
MOV AH,09         ;Come here to print an
INT 21            ;error message and end the
MOV AX,4C01       ;program
INT 21
MOV AH,52         ;Get the SFT's base address
INT 21            ;with undocumented function
;52h
ES:              ;Transfer the address to
;ES:DI
MOV DI,[BX+04]
ES:
MOV ES,[8X+06]
ES:              ;Add number of SFT entries
MOV AX,[DI+04]   ;in this block to the total
ADD [0106],AX
CALL 01FF        ;Now count the USED entries
ADD [0108],AX    ;in this block
ES:              ;Get the address of the
MOV BX,[DI]      ;next SFT block in ES:BX
ES:
MOV ES,[DI+02]
MOV DI,BX        ;Loop back for more if this
CMP DI,-01       ;isn't the final block
JNZ 0185
MOV AH,09        ;Display the results

MOV DX,0124      ;DX->"Number of SFT entries:"
INT 21
MOV AX,[0106]    ;Display number of SFT entries
CALL 021C
MOV AH,09        ;Go to the next line
MOV DX,015D
INT 21
MOV AH,09
MOV DX,013C      ;DX->"Maximum number..."
INT 21
MOV AX,[0108]    ;Display used entry count
CALL 021C
MOV AH,09        ;Go to the next line
MOV DX,015D
INT 21
MOV AX,4C00      ;Get outta here!
INT 21
PUSH DI          ;Subroutine to count the
ES:              ;number of used SFT entries
MOV CX,[DI+04]   ;in this block
ADD DI,[0102]
ADD DI,+06
XOR AX,AX
ES:
CMP WORD PTR [DI],+00
JZ 0214
INC AX
ADD DI,[0104]
LOOP 020D
POP DI
RET
MOV BX,000A      ;Subroutine to convert the
XOR CX,CX        ;value in AX to ASCII text and
INC CX           ;output it to the screen
XOR DX,DX
DIV BX
PUSH DX
OR AX,AX
JNZ 0221
POP DX
ADD DL,30
MOV AH,02
INT 21
LOOP 022B
RET

N FILECHK.COM
RCX
136
W
Q

```

FIGURE 3: This is the assembly-language listing for FILECHK.COM.

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enabled? Not at all. The limitation imposed by the FILES setting still applies, so going through the optimization process is still worthwhile.

If you run FILECHK under Windows 95, you will be greeted by the error message "Unsupported DOS version." Gauging file utilization is tricky in Windows 95, because Windows 95 acts a lot like Windows for Workgroups 3.11 with 32-bit file access permanently enabled. In addition, Windows 95 writes some unfamiliar data to SFT entries, perhaps in support of long filenames. For now, the best strategy for Windows 95 is to set FILES equal to 20 or 30 and let the system handle the rest. If some of your applications, particularly DOS apps, complain about a lack of file handles, increase the FILES setting in increments of 5 or 10 until you find one that works.

MOVING THE SFT TO UPPER MEMORY

If the optimum FILES setting for your PC is rather large and you'd like to free up more memory for DOS applications, you can use *PC Magazine's* UMBFILES utility to move most of the system file table to upper memory. (Some memory managers, including QEMM, also provide utilities that do this.)

If the FILES setting for your PC is large and you'd like to free more memory, you can use our UMBFILES utility to move most of the SFT to upper memory.

Starting your PC with a FILES=8 statement in CONFIG.SYS and a UMBFILES=52 statement in AUTOEXEC.BAT is equivalent to FILES=60, but using UMBFILES drastically reduces the amount of conventional memory consumed by the system file table. One caveat is that Windows sometimes requires a FILES setting of 10 or 12 to start, so you may need a FILES setting slightly higher than FILES=8 to run Windows.

Every byte of conventional memory is precious when you run DOS applications, so it's certainly in your best interest to make sure FILES isn't set any higher than necessary. Don't let extra memory go to waste in the system file table; instead, find the optimum FILES setting for your PC and put the leftover memory to work on behalf of your programs. □



PC Tech/ Inside Windows 95

By Matt Pietrek

OS Crash Tests

Here's a look inside the utilities we use to test operating system robustness and capacity.

In this issue's cover story, we probed the comparative robustness and capacity of Microsoft Windows 3.1x, Microsoft Windows 95, IBM's OS/2 Warp Connect Version 3.0, and Microsoft Windows NT Workstation 3.51 using a suite of test applications that I wrote for this purpose. Here, we will examine the inner workings of these applications while providing some insight into the architecture of the tested operating systems. The tests fall into four categories:

- The BOMB16 and BOMB32 programs test each operating system's memory-overwrite protection.
- The THRDTEST program lets you create system threads with queues and without queues while tracking free system resources and thread counts.
- The W16MTX16 and W16MTX32 programs demonstrate the effect of the Win16Mutex.
- The WNDTST16 and WNDTST32 programs test the number of windows that can be created.

The 16-bit and 32-bit Windows programs were written with Microsoft Visual C++ 1.5 and Visual C++ 2.0, respectively. The 32-bit code was then ported to OS/2 using Borland C++ for OS/2 2.0; because the Win32 API and the Warp API have a common ancestor in the OS/2 1.3 API, almost all of the Win32 calls had equivalents in OS/2 (the Overwrite System DLL portion of the BOMB32 test had to be modified to point to an OS/2-specific system component, however). THRDTEST is specific to Windows 95 only and was not ported.

If you are interested in experimenting with these tests, you can download their source code and binaries from the PC Magazine Labs World-Wide Web page (<http://www.zdnet.com/~pcmag/pclabs/pclabs.htm>) or from the PC Labs library of ZiffNet's Utilities/Tips Forum (GO ZNT:TIPS on CompuServe).

BOMBS AWAY

The BOMB16 program, used to test operating system robustness, has three components for

generating three different types of exceptions. The first is designed to generate a straightforward general protection fault (GPF). This test uses its code segment as the selector for a data pointer, then causes a code fault by writing with that pointer. In all of the tested operating systems, clicking on BOMB16's Common GP Fault button triggers an error message box that notifies the user of an illegal operation. All the operating systems then terminate the offending application and continue to execute with no effect on other programs.

The second BOMB16 test, Overwrite Conventional Memory Below Start of Windows, demonstrates that the low portion of conventional memory in some Windows versions is

similar effect. The Overwrite System DLL test locates the data segment of a key 16-bit system DLL and writes zeros to its entire length. Locating the data segment of a system DLL is trivial: A call to LoadLibrary returns the DLL's HINSTANCE, which is effectively the same value as the DLL's data-segment selector. BOMB16 crashes Windows 3.1x and Windows 95 by overwriting the KRNL386.EXE system DLL; overwriting the USER.EXE or GDI.EXE data segments would yield equally catastrophic results. In Windows NT and OS/2, the code for supporting Win16 applications is isolated from the rest of the system, so the test simply shuts down the 16-bit session in which it is running.

BOMBS IN 32 BITS

BOMB32 is a port of BOMB16 to the Win32 environment. Instead of causing a GPF by writing to a code segment, BOMB32's Common Page Fault causes a similar failure by attempting to write to one of its own code pages. A page fault occurs because Win32 operating

systems use paging rather than segmentation to protect read-only sections of memory. All three 32-bit operating systems simply post an error message and close the application (see Figure 1).

BOMB32 also has two separate tests that write to memory below 1MB: Overwrite Conventional Memory Below Start of Windows and Overwrite Conventional Memory Above Start of Windows. Windows 95 can recover from one but not the other. In Windows 95, the data segment used for 32-bit programs is an expand-down segment rather than a true flat selector. An expand-down segment is limited by the lowest possible offset that can be

accessed without a GPF. The maximum usable offset for a 32-bit expand-down segment is 0xFFFFFFFF. Windows 95 sets the limit of the segment to the lowest address in the 16-bit global heap, which starts in conventional memory below 1MB. By using an expand-down selector, Windows 95 protects all of the DOS memory that is below Windows. Thus, BOMB32's Overwrite Conventional Memory Below Start of Windows causes an error under Windows 95, but the system easily terminates the errant application. Windows NT and OS/2 react in the same manner.

All the conventional memory above the

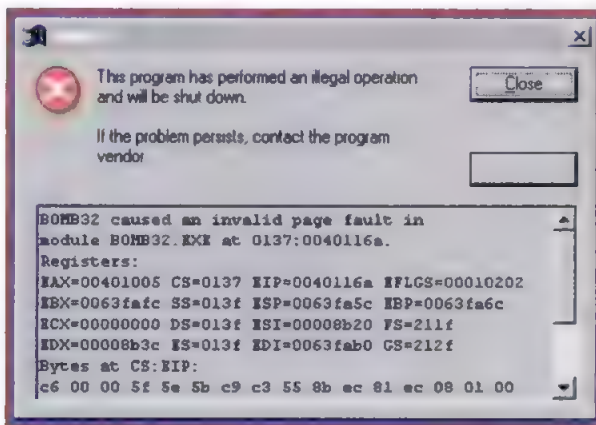


FIGURE 1: BOMB32 triggers a protection fault in Windows 95. Overwriting unprotected system areas brings the whole show down.

not protected from malicious 16-bit applications. The 0000h selector in Windows 3.1x and Windows 95 makes the first 64K of conventional memory available to any 16-bit Windows program. BOMB16 creates a far pointer using this selector and writes a 64K block of zeros to that location. This instantly crashes Windows 3.1x and Windows 95. Windows NT and OS/2, however, handle the overwrite more gracefully; Windows NT correctly terminates the test without disturbing other applications, while Warp completely shuts down the Win-OS/2 session that houses the 16-bit test.

The final trick in the BOMB16 bag has a

start of the global heap, however, is unprotected from the 32-bit expand-down selector. For Overwrite Conventional Memory Above Start of Windows, BOMB32 must find the limit of the 32-bit data segment so that it knows where Windows begins. It calculates the limit of the Win32 data selector using a little-known function called `GetThreadSelectorLimit()`.

`GetThreadSelectorLimit()` copies the contents of a Local Descriptor Table entry into an 8-byte buffer, and BOMB32 decodes the descriptor entry fields. If BOMB32 determines that the segment is an expand-down segment, then it calculates the descriptor's limit. When running under Windows 95, BOMB32 rounds up the limit of the expand-down selector to the nearest page and enters a loop that overwrites each subsequent page below 1MB. Since low portions of the global heap are overwritten, the system immediately crashes. If any of the pages are marked read-only, the loop uses a `_try/_except` block to catch page faults and keep the loop going. Because the Win32 data selector is not an expand-down segment under Windows NT, BOMB32 starts page overwrites at offset 0. Windows NT and OS/2, however, suffer no ill effects from attempts to write in low memory.

The Overwrite System DLL button in BOMB32 differs slightly from its 16-bit counterpart. First, it uses `GetModuleHandle` to locate the start of the KERNEL32 system DLL in memory. Using the `IMAGE_DOS_HEADER` and `IMAGE_NT_HEADERS` structures defined in `WINNT.H`, BOMB32 locates then iterates through the KERNEL32 module in memory until it finds the `.data` section. When the test writes zeros to the entire length of the `.data` section, Windows 95 promptly crashes. Windows NT, however, recovers gracefully, because system DLLs like KERNEL32 don't share memory between applications. The OS/2 port of the Overwrite System DLL attempts to overwrite a writable code page in `PMWIN.DLL`. This immediately brings down the system.

THREADS AND RESOURCES

Of all the test applications in this suite, `THRDTEST` is the most sophisticated: It displays the number of system threads and the amount of free system resources, while allowing the user to create additional threads at will. The code is specific to Windows 95 and will not run on the other 32-bit platforms, however. This is because the concept of free system resources is not relevant to Windows NT and OS/2; they do not use 16-bit 64K resource heaps and there is essentially no theoretical limit to the number of threads they can support. In Windows 3.1x, of course, threads are not supported at all.

To retrieve the number of threads in Windows 95, `THRDTEST` reads the `KERNEL\`

`Threads` value from the `HKEY_DYN_DATA\PerfStats\StatData` registry key. (Interestingly, retrieving the equivalent value in Windows NT requires a completely unrelated registry key. Microsoft claims that the Win32 API is common to Windows NT and Windows 95, but there are differences such as this one that make programmers pull their hair out.)

Displaying the free system resources for the USER and GDI heaps is more difficult. While the `GetFreeSystemResources` function still exists in Windows 95, it is in the 16-bit `USER.EXE`. Since `THRDTEST` needs to be a 32-bit app to create threads, calling the 16-bit `GetFreeSystemResources` function poses a problem. Normally, this requires a *thunk*, a short routine that converts between 16-bit and 32-bit environments. According to documentation, Windows 95 thunks require separate 16- and 32-bit thunk DLLs. The Windows 95 32-bit system DLLs, however, routinely call functions in the 16-bit DLLs without using intermediate DLLs. There is no reason why `THRDTEST` cannot do the same.

There are two keys to calling the 16-bit `GetFreeSystemResources` function from Win32 code. First, `THRDTEST` needs the function's 16-bit far address. The code obtains this via the undocumented `LoadLibrary16`, `FreeLibrary16`, and `GetProcAddress16` functions in `KERNEL32.DLL`. These functions do not appear in the normal `KERNEL32.LIB` import library that Microsoft provides, but you can create a new import library using a `.DEF` file and the Microsoft `LIB` program. An import library is the means by which the linker resolves calls from application code to functions that reside in the DLLs.

Once `GetProcAddress16` returns the 16-bit segmented address of `GetFreeSystemResources`, the code must tackle a second problem: It cannot simply make a `FAR CALL` to the address. For one, the 16-bit function will encounter a 32-bit flat stack when it expects to execute on a 16-bit stack. And second, a direct call to the 16:16 address would bypass the `Win16Mutex` issue. When Win32 code calls Win16 code, it must acquire the `Win16Mutex` so that another thread will not attempt to access the 16-bit code concurrently.

The answer to both these problems is to call `GetProcAddress16` via the undocumented `QT_Thunk` function that is exported by the Windows 95 `KERNEL32.DLL`. This is as simple as pushing the arguments on the stack, loading `EDX` with the 16:16 target address, and then making a `CALL` to the `QT_Thunk` function. `QT_Thunk` allows `THRDTEST` to get the free system resources for the USER and GDI heaps without dragging in two additional thunk DLLs. Of course, `THRDTEST` can run only on Windows 95 due to the uniqueness of the `QT_Thunk` function. The follow-

ing assembler listing shows how the free system resources are obtained via the `QT_Thunk` function:

```
__asm {
    push    2 // GFSR_USERRESOURCES
    mov     edx, [pfnFreeSystemResources]
    call    QT_Thunk
    movzx   eax, ax
    mov     [user_fsr], eax
}
```

Lastly, `THRDTEST` allows you to create additional threads, both with and without message queues. As the cover story mentions, threads with message queues drain USER's free system resources, while threads without queues do not. The threads created by `THRDTEST` are merely infinite loops that call the `GetLastError` function. To spawn a message queue, however, the loop must also call the `GetFocus` function. The focus window is something that Windows 95 and Windows NT maintain on a per-thread basis. A new Windows 95 thread does not have a queue associated with it, but when it calls a function such as `GetFocus` that requires queue-specific data, Windows 95 creates a queue. In Windows 95, the practical upper limit for threads with message queues is roughly 450.

THE WIN16MUTEX

Although it does not affect 32-bit applications, the `Win16Mutex` can cause problems with 16-bit applications that are slow to yield control of the CPU. To test this issue, a single piece of code (`W16MUTEX.C`) was compiled to both 16 and 32 bits (`W16MTX16.EXE` and `W32MTX32.EXE`). Each version creates a pair of small clock windows that are updated once per second. If the `Win16Mutex` is not interfering, both clocks are updated simultaneously.

When the Block for 10 Seconds command is selected, one clock window calls `GetTickCount` for 10 seconds. In Windows 3.1x, the second clock window cannot receive CPU time because the operating system relies on cooperative multitasking. If the second window is to operate, the first window must yield control of the CPU by calling a function such as `GetMessage` or `PeekMessage`. Since some Win16 programs rely on cooperative multitasking, Windows 95 retains this scheduling behavior and forces all 16-bit applications to own the `Win16Mutex` while running. Consequently, the 16-bit `W16MTX16` performs the same under Windows 95, Windows 3.1x, and Win-OS/2: While the first window is looping for 10 seconds, the second window cannot perform because it requires thunking down to 16-bit code. Windows NT, however, can circumvent this behavior by running each 16-bit application in its own Windows VM.

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In the 32-bit test, Block for 10 Seconds affects only the first clock window. The second window continues to update normally, because Windows 95 lets Win32 applications run without owning the Win16Mutex. The 32-bit applications own the Win16Mutex only when they thunk down to 16-bit DLLs like USER or GDI. Of course, Windows NT does not have a native Win16Mutex, so the nonyielding 32-bit clock does not affect the second window. OS/2, however, has an input system that is similar to Windows 3.1x, and applications that are slow to yield control will prevent others from running. Fortunately, OS/2 will detect when an application is monopolizing the CPU, and it will redistribute control. Under W32MTX32, therefore, the second clock slowed down (but did not stop) when the first was blocked.

CREATING WINDOWS

Like the Win16Mutex applications, WNDTEST16 and WNDTEST32 compile from the same source file (WNDTEST.C). Both versions continually spawn button-class windows until 1,600 windows have been created or the CreateWindow function fails. The applications then report how many windows were actually created. Although the theoretical maximum is 16,384 windows for Windows 95 and an infinite number for Windows NT, the WNDTEST applications stop at 1,600 because creating and subsequently destroying so many windows is painfully slow. The process is further slowed by a PeekMessage loop that is executed after each CreateWindow call; without this loop, the button windows would not be visible and the application's progress could not be monitored. Should the process become too slow, changing the MAX_X and MAX_Y values in WNDTEST.C and then recompiling will decrease execution time.

Contrary to some reports during the Windows 95 beta test period, creating a window in Windows 95 takes up absolutely no space in USER's main 64KB heap. To verify this, the 16-bit WNDTEST16.EXE calls GetFreeSystemResources before it executes, after the windows have been created, and after the windows have been destroyed. It then displays all three free-system-resource values, which should be roughly the same. Since the 32-bit version (WNDTEST32.EXE) had to run on Windows NT and OS/2, it does not use the nonportable code that the THRDTEST program uses to get the free-system-resource value under Windows 95.

The cover story reports the results of running WNDTEST. To recap, however, the 16-bit WNDTEST16 can create roughly 800 windows when run under Windows 3.1x or Win-OS/2. On Windows 95 and Windows NT, it can reach the 1,600-window maximum. WNDTEST32 turned in results similar to WNDTEST16 on Windows 95, Windows NT, and OS/2. □

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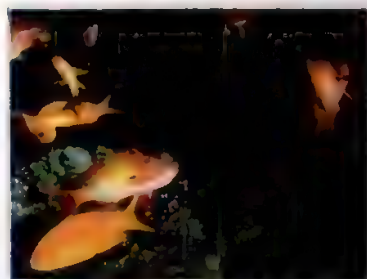


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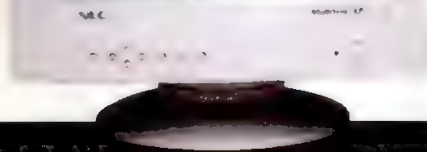
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PC Tech/Power Programming

By Ray Duncan

The Readers Strike Back

This time it's your turn to offer insight and corrections about the Web and WinHelp.

Many articles on electronic publishing with Windows Help and the World-Wide Web have provoked an astonishing amount of e-mail from readers. We're at a good point in this series of columns to regroup, retrench, and patch up some errors of omission and commission, so I've picked out just a few of the many messages of general interest to publish here.

THE MICROSOFT MULTIMEDIA PUBLISHING TOOLKIT

We have been doing hypermedia publishing with a WinHelp-based tool named WinHelp Magician and have met up with problems (256-color difficulties) in linking bitmaps and creating hotspots. We read your article about Microsoft Multimedia Publishing Toolkit but have not been able to find this product.

MARKKU SIPPOLA, via the Internet

Multimedia Publishing Toolkit is no longer just relatively inexpensive, it's included on the Multimedia Jump Start 2.0 CD-ROM, available for free from Microsoft. No manuals come with that, though. You can request the CD-ROM by sending e-mail to mmdinfo@microsoft.com with a shipping address (not a P.O. box) and phone number.

STEPHEN PRUITT, via CompuServe

I have used .HLP files in a first-year biology course on lower plants, algae, and fungi with great success. My only problem with this system is the inability to customize the user interface. While Microsoft Multimedia Viewer is a good alternative, there is another, MediaView Toolkit (available from FTPMICROSOFT.COM as the file MV12KIT.ZIP and on the Microsoft Developer Network CD-ROM).

ALAN AMORY, via the Internet

Thanks for the information on Microsoft Multimedia Viewer. I found two patched programs on the Microsoft FTP server (FTPMICROSOFT.COM). There is a new viewer file and a new compiler file, VWR20A.ZIP and WMVC.ZIP, respectively. They take care of formatting problems with fonts and incompatibilities with Word for Windows, Version 6.0. I got

the information from the TechNet CD-ROM for February 1995. I find it amazing that I can buy a new shrink-wrapped product and immediately need to spend half a day Net surfing to get the latest debugged versions of the files.

BERT SCHULTZ, via the Internet

As you can see from these letters, from the time of my writing the articles mentioning Microsoft Multimedia Publishing Toolkit to their appearing in *PC Magazine*, the toolkit became a desupported "free" product, presumably in preparation for its complete disappearance.

MediaView, which has been mentioned as Multimedia Publishing Toolkit's successor, has many interesting features and is appar-

ently the basis for the search engines in the various Microsoft consumer CD-ROM products, such as Cinemania and Encarta. But it is supplied as is and unsupported. More important, it does not have any built-in user interface—only an API, which can be called from C or C++ applications that serve as front ends. So the MediaView toolkit, unlike the older Multimedia Publishing Toolkit, is really only an option for multimedia developers who have expert C/C++ programmers to deploy on a project.

The issue may be moot anyway, since the Windows 95 help compiler and viewer combine many of the best features of both the Windows 3.1 Help system and the Multimedia Publishing Toolkit. It's probably wisest to wait and evaluate the market penetration and user acceptance of Windows 95 before committing to any large new electronic publishing projects with any of these tools.

CROSS-PLATFORM WINHELP

After my remarks in the issue of January 10, 1995, about using .HLP files for electronic

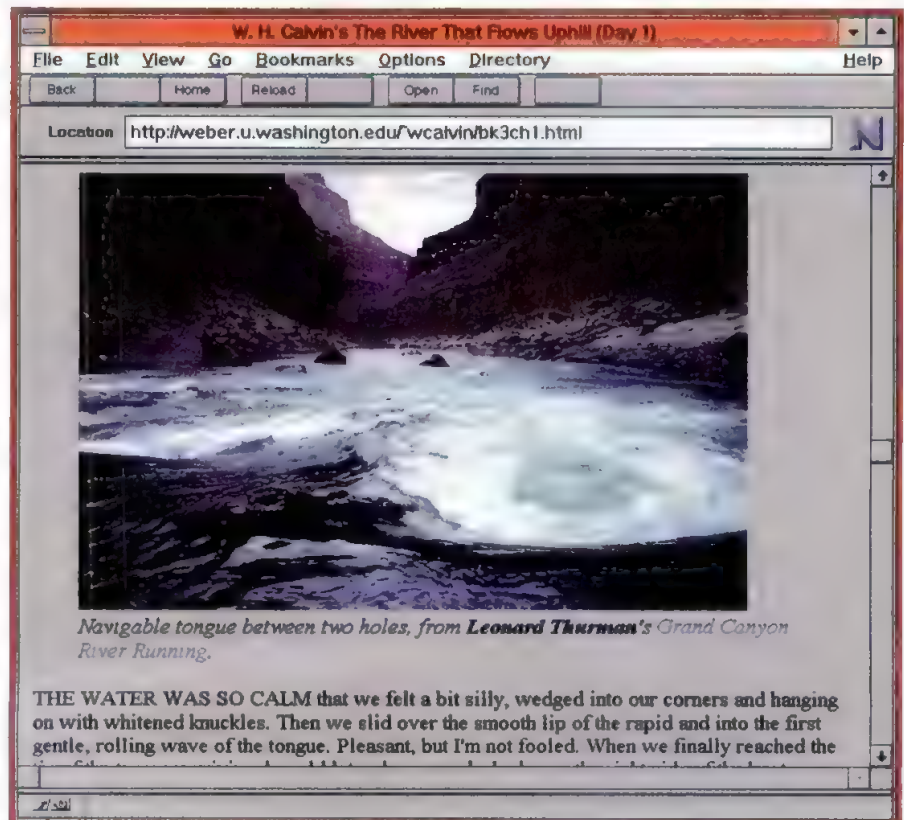


FIGURE 1: The on-line version of William Calvin's book, *The River that Flows Uphill*, makes impressive use of multimedia from distributed sources.

publishing on both Microsoft Windows and the Macintosh, many readers wrote to me with pleas for more information. The following are typical of their letters:

Your article about the Microsoft Help Engine on the Macintosh sounded very promising. Actually making the transfer proved just as easy as you claimed. However, the graphics were garbage, and there seemed to be no way to deal with applications that want context-sensitive help. After quite a bit of research, I was able to dig up information on how to deal with the graphics. But there doesn't seem to be any way (short of doing all your programming with Visual C++ Cross-Platform Edition) of specifying that a specific topic should be displayed.

I have talked to Microsoft, and representatives say they are currently not giving out any information. The representative I talked to says that he is going to try making a Macintosh code resource that will do the trick, which we can then include in our Macintosh application. But he didn't sound exactly encouraging. The \$1,800 for the cross-platform version of Visual C++ seems a bit steep just to get context-sensitive help.

DON LAMMERS, via CompuServe

I've just been on the phone with a Microsoft support person who informed me that the Microsoft Help system was included with FoxPro and Visual C++ for the Macintosh, but since we were not using those for development the cost would be a whopping \$10,000 for a license. I'll give the support person credit for scoffing at the price as well. We do own a copy of FoxPro for Macintosh, but I can't find the distribution agreement anywhere. Since I work for a software company, I'd like to make sure that we're within our rights to distribute it royalty free.

CLAIRE DOLAN, via CompuServe

The crucial language with respect to redistribution of the Microsoft Help viewer on the Macintosh can be found in the Microsoft Knowledge Base article Q117354, "Distributing Help Files for FoxPro for the Macintosh," dated September 16, 1994.

"The information in this article applies to: Microsoft FoxPro for Macintosh Distribution Kit, Versions 2.5b, 2.5c. If your application includes a graphical help file, you can also distribute the Microsoft Help Engine by adding the FoxPro Help and Microsoft Help files to your application folder. These two files are located in the System Folder:Extensions:Microsoft:Help folder. These files were

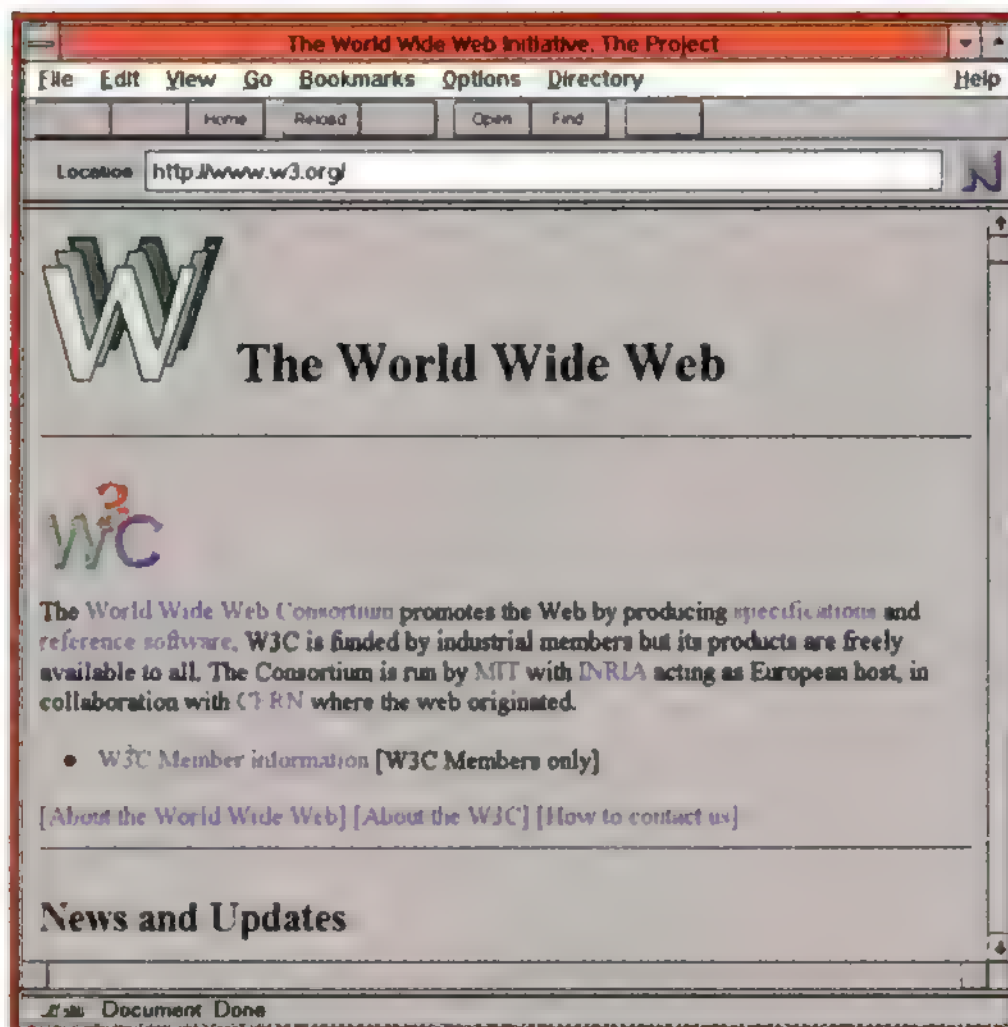


FIGURE 2: The home page of the World-Wide Web has changed its address. The World-Wide Web Consortium maintains this page at its new URL, <http://www.w3.org>.

omitted from the list of distributable files on page 8 of the User's Guide for the FoxPro for Macintosh Distribution Kit. However, they are listed as distributable files in the DK ReadMe file. Note: As listed on page 8 of the Distribution Kit User's Guide, the FOXHELP.DBF, FOXHELP.FPT, and FOXHELP.HLP files in the FoxPro folder CANNOT be distributed."

I must say that since I wrote the original article, my hopes for low-cost, cross-platform electronic publishing on the Macintosh by taking advantage of the Microsoft Help viewer have been severely dashed. Given Microsoft's declining interest in and support for its own Macintosh applications, the nearly complete lack of documentation on the Macintosh Help Viewer and its capabilities, and the absence of a Macintosh-based .HLP file compiler, I think the wisest strategy is to look elsewhere. At present, there appear to be two vendors selling commercial-grade WinHelp-compatible development tools for the Macintosh: Altura Software and Foundation Solutions.

Altura Software sells QuickHelp and QuickView, Macintosh-based development packages that are compatible with the Windows 3.1 Help Compiler/Viewer and the Microsoft Multimedia Compiler/Viewer, respectively. In order to use the Altura products, you move your RTF and bitmap source files from your Windows development system to a Macintosh (preferably a relatively fast machine with a 68030 CPU or better), recompile them using the Altura compilers, and then distribute the resulting files along

with the Altura viewer programs. In my own quick experiments with an evaluation copy of the QuickView package, compatibility of the Altura compiler with the Microsoft equivalent appeared to be quite good, and the Altura products include a number of nice features such as automatic font mapping and bitmap conversion.

The only fly in the ointment with the Altura products is the cost: The QuickHelp and QuickView developer kits each cost \$495, which is reasonable, but distribution licenses for noncommercial titles start at \$495 for QuickHelp and \$995 for QuickView, and at \$2,500 each for commercial titles. This, unfortunately, puts these products out of reach for most independent software developers and electronic publishers. If you would like more information, you can contact Altura Software at 510 Lighthouse Ave., #5, Pacific Grove, CA 93950; 408-655-8005; fax, 408-655-9663; or send Internet

mail to evaluation@altura.com.

Foundation Solutions sells a development package called Ehel. One reader reported to me that he bought an evaluation copy and had his Windows Help file recompiled and running on the Macintosh within an hour. You can contact Foundation Solutions at 2000 Regency Pkwy., #270, Cary, NC 27511; 919-481-3517; fax, 919-481-3551.

HELP COMPILER UPDATE

When I try to compile .RTF files written with Word for Windows, Version 6.0, I get an error message. But it compiles smoothly when I write the file using DOS Word 5.5. I'm using the HC31.EXE, which came with Visual Basic, Version 3.0.

DIBAKAR RAY, via the Internet

Do you know where to upgrade my Windows Help Compiler (from Version 3.10.425 to 3.10.505) so I can use the WHAT6 WinHelp macros?

DAVE SUTTON, via the Internet

The file that both of you want is HC505.EXE. This is a self-extracting archive file which unpacks itself into Version 3.10.505 of HC.EXE and HCPREX (the extended-memory-aware version of HC.EXE). You can find this update on the FTP server [FTP.MICROSOFT.COM](ftp://FTP.MICROSOFT.COM) and in the Microsoft software developer forums on CompuServe.

WINHELP REFERENCES

In the issue of February 7, 1995, you referred to books on help-file construction. Can you pro-

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Power Programming

vide more detailed information about these books?

MARK SIMONIAN, via the Internet

Here are the only two books on WinHelp that I am aware of:

Developing On-Line Help for Windows, by Scott Boggan, David Farkas, and Joe Welinske (includes disk with WinWord templates, examples, and bitmaps); Sams Publishing, Carmel, IN, 1993, 462 pages, \$39.95. ISBN 0-672-30230-6.

The Developer's Guide to WINHELPEXE, by Jim Mischel; John Wiley and Sons, New York, NY, 1994, 383 pages, \$39.95. ISBN 0-471-30325-9.

These books have somewhat different orientations. Boggan's book is directed at non-programmers and contains a great deal of useful advice about the style, structure, and planning of help files. The Mischel book is programmer-oriented and contains source examples of how to build DLLs for WinHelp and calling the WinHelp API. Unfortunately, as far as I can tell, Boggan's book is currently out of print, but you may be able to find copies in stock at large technical bookstores such as Computer Literacy (<http://www.clbooks.com>).

THE IMPORTANCE OF <TITLE> TAGS

I urge you to encourage your readers to (1) use meaningful titles in HTML documents and (2) put some text around their links so that visitors can know what to expect if they follow the link.

First, although you alluded to the information in <HEAD> and, in particular, <TITLE>, you failed to stress how important the choice of title is for a page. It is what people will see in any list like What's New or Yahoo, it is what appears in bookmarks, and it is there in clear blue and white at the top of the screen. It should be chosen carefully, because it is the identity of the page. Too many times I have seen cryptic acronyms as titles which lead me to forget to revisit the site. Also, with local links, I often find the same title on each page. If I add it to the bookmark list, I don't know which is which.

Second, very few sites really take advantage of hypertext—the pages they write are really glorified Gopher pages. The lists are not described in a way that makes one sure whether or not to follow a link, and in many cases an interesting link is passed by. In some cases, like the Yahoo Hierarchical Index, you're sure of what's underneath. But in most cases it's helpful to have a bit of description, because usually the visitor does not have a clue as to the nature of the destination of the link.

DOUGLAS ANDERSON, via the Internet

SOME HTML CLARIFICATIONS

The Power Programming column in the June 13, 1995, issue has several conceptual errors in

it. The <P> tag marks the beginning of a new paragraph, not the ending of one. The difference is slight, but it is there. The <LISTING>...</LISTING> tag is considered obsolete and should be replaced by the <PRE>...</PRE> tag or the <CODE>...</CODE> tag. Also, the important comment <!doctype html public "-//W30//DTD W3 HTML 2.0//EN"> was omitted. (That doesn't really have any purpose except to identify the SGML DTD version to... people who want to know, I suppose. But all the well-written HTML stuff I've seen has that code right at the top.) You also failed to point out that in an tag, the filename for a .GIF file must end in the extension .gif. MPEG files, however, can end in .mpg or .mpeg.

DAVID ROSOFF, via Internet

I am embarrassed about the <P> tag. In some early HTML documentation that I read, it was described as an end-of-paragraph marker, and since (as Mr. Rosoff suggests) under ordinary circumstances it works fine when used with either type of placement, I never bothered to look it up in more recent HTML tutorials and never caught on to its correct meaning. As for the <!doctype> tag, these seem to be quite rare, so I guess I'm missing most of the "well-written" stuff!

THE LOUVRE IT AIN'T

You've probably heard this a thousand times by now, but Le WebLouvre, Paris (now WebMuseum) is not the official organ of the Louvre.

KIRK BRASHEAR, via the Internet

You are quite right. I was so dazzled by the on-line availability of some of my favorite Impressionist paintings that I failed to read the fine print. In reality, Le WebLouvre is the brainchild of a single talented student, Nicolas Pioch at the École Polytechnique in Paris, and he has recently been the target of legal threats by the bureaucrats of the real Louvre, forcing a change in hostnames. In spite of this harassment, WebMuseum has continued to thrive and is now mirrored on numerous Web servers throughout the world. A connection point with good performance in North America is at URL: <http://sunsite.unc.edu/louvre/>.

GOOD READING ON THE WEB

I've been putting some of my books on Web pages and, with The River That Flows Uphill (Sierra Club Books), have discovered an interesting way of doing multimedia from distributed sources. It's available on the Web with live links at <http://weber.u.washington.edu/wcalvin/faq.html>, and the River book itself starts at <http://weber.u.washington.edu/wcalvin/bk3.html>.

WILLIAM H. CALVIN, via the Internet

This on-line book (Figure 1), as well as the

many other books and resources made available on the Web by William Calvin, is truly impressive and should be studied by every aspiring electronic publisher.

THE WORLD-WIDE WEB'S HOME PAGE

In your article of April 11, 1995, you mentioned the World-Wide Web home page at CERN <http://info.cern.ch> as a source of a variety of Web software and documentation. All this stuff is no longer being maintained by CERN. The new URL for the Web Home Page is <http://www.w3.org>, maintained by the World-Wide Web Consortium.

GENNADY NESANELIS, via the Internet

Thank you for the correction (which was also e-mailed to me by several dozen other readers). This only underlines the pitfalls one faces when writing about a dynamic, rapidly evolving entity such as the World-Wide Web in a traditional print medium. I encourage all readers to use printed books and articles about the Web with caution and to seek out information sources on the Web itself for the latest and most detailed information. Figure 2 shows the Web home page that you'll find at the new URL.

WEB SERVERS FOR OS/2

After my article about setting up a World-Wide Web server in the issue of May 16, 1995, which used the Windows NT-based EMWACS 0.96 HTTPS server software as an example, I received a flurry of outraged e-mail from OS/2 zealots. (A typical message started out, "What is with your irrational fascination with Windows NT when it comes to HTTP servers," and went downhill from there.) Fortunately, one reader adopted a more reasonable and informative approach:

Reading your article in PC Magazine, I found that you covered OS/2 very lightly. This is understandable, as this information is hard to find. Here is a news post which describes some of the tools available to OS/2 users and how to obtain them. There are more than the ones mentioned below, especially with regards to writing HTML.

Web Site Authoring: The best tool on any platform (in my humble opinion) for developing Web pages is the SPHyDir tool available from PC Lube&Tune. This tool puts solutions like HoTMetaL and Microsoft Internet Assistant to shame with its slick object-oriented, drag-and-drop environment. Creating links between pages is as simple as dragging a URL from your Web Explorer hotlist onto an icon on the page. The same goes for graphics and forms. It's almost too easy. SPHyDir is free as long as pages built with it display a small plug for the SPHyDir author, Howard Gilbert. Commercial licenses are available. Check it out at

Power Programming

<http://pclt.cis.yale.edu/pclt/sphedir/sphedir.htm>.

Web Serving: IBM's GoServe WWW Server is available for serving HTTP requests on the OS/2 Warp platform. Along with the robust 32-bit TCP/IP stack built into OS/2 Warp Connect, GoServe transforms OS/2 into a high-speed, incredibly efficient HTTP server. GoServe can be locally administered through the graphical WorkPlace shell interface, or it can be remotely controlled through a Web browser. It supports user limits and caching, and can even serve double duty as a Gopher server! It supports REXX scripts for forms support and image mapping, making the learning curve for building complex Web sites very short. It leverages the multithreaded architecture of OS/2 Warp by dispatching separate threads for client requests. The best feature is the price: It's free! GoServe was developed by Mike Cowlshaw, an IBM Fellow who also happened to design, develop, and evangelize the cross-platform REXX programming language. Find out more at <http://www2.hursley.ibm.com/goserve/>.

Web Browsing: IBM's WebExplorer is included free with OS/2 Warp, and its tight integration with both SPHDir and the OS/2 WorkPlace Shell make it the browser of choice for Web authors. Any graphic from any page, whether specified by the author as downloadable or not, can simply be dragged off the page and onto the WorkPlace Shell, where it is saved in its native format. The same will soon be the case for entire Web pages. (This feature is currently in beta.) The WebExplorer can launch up to eight worker threads, allowing it to receive, decode, and display data in parallel rather than serially. The faster your link to the Net, the more you'll notice this feature. WebExplorer is a modern browser that supports FTP, Gopher, HTML, Mailto, and News in a seamless, integrated fashion. If you would like the latest production-level or beta-level copy of WebExplorer, anonymous FTP to <ftp://ftp.ibm.net/pub/WebExplorer>.

TARJEI JENSEN, via the Internet

HTML TAGS AND REFERENCES

Thank you for providing a readable summary of the basic HTML tags. I was wondering if you have assembled a similar grouping of HTML Form tags? Can you advise where I might find basic, easy-to-understand information on this topic?

PAT MILLER, via the Internet

Can you center text and images? I found one book that said it wasn't possible, but then I see it happening all over the Web, so I'm confused.

AMANDA BURROUGHS, via the Internet

I'm a programmer/analyst working for the San Bernardino School District in California. I want to learn how to create World-Wide Web

documents. Can you recommend any books on HTML programming and World-Wide Web publishing, especially for beginners?

NESTOR ORDONEZ, via the Internet

The best sources of information about HTML and Web publishing are on the Web itself. One good jumping-off point for tutorial information is a directory compiled by the folks at the Stanford Linear Accelerator Center with URL: <http://heplibw3.slac.stanford.edu/FIND/wwwbibl.html>.

Nevertheless, as I'm sure you've noticed, the traditional book publishers have inundated the market with Internet titles. No niche has been left unexploited, although many of the books are barely readable or quick rehashes of free information available on the Internet itself. Predictably enough, there is even a book called *HTML for Dummies*! But there are a few worthwhile books out there, and here are four books on HTML that I have read and found useful:

HTML Manual of Style, by Larry Aronson. Ziff-Davis Press, Emeryville, CA, 1994, 132 pages, \$19.95. ISBN 1-56276-300-8.

HTML for Fun and Profit, by Mary E. S. Morris (includes a CD-ROM with server software, example HTML documents, and CGI scripts for Unix, Windows and Windows NT, and Macintosh). Prentice Hall, Upper Saddle River, NJ, 1995, 264 pages, \$35.95. ISBN 0-13-359290-1.

The HTML Sourcebook, by Ian S. Graham. John Wiley & Sons, New York, NY, 1995, 416 pages, \$29.95. ISBN 0-471-11849-4.

Spinning the Web, by Andrew Ford. Van Nostrand Reinhold, New York, NY, 1995, 227 pages, \$29.95. ISBN 0-442-01996-3.

Managing Internet Information Services, by Cricket Liu, Jerry Peek, Russ Jones, Bryan Buus, and Adrian Nye. O'Reilly and Associates, Sebastopol, CA, 1994, 630 pages, \$29.95. ISBN 1-56592-062-7.

Aronson's book is a concise, clear introduction to HTML coding and includes a section on the proposed HTML 3.0 extensions and on the special tags supported by Netscape Navigator. The Morris and Graham books are good mid-level treatments with lots of coding examples and screenshots. The Ford book is Unix-centric and definitely the book to buy if you are running the NCSA or CERN HTTP server demons. Finally, the book by Liu, Peek, Jones, Buus, and Nye provides the only comprehensive discussion of all kinds of Internet information servers, including finger, telnet, news, WAIS, Gopher, and World-Wide Web.

THE IN BOX

Please send your comments and suggestions to me at any of the following e-mail addresses:

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CIRCLE 285 ON READER SERVICE CARD



PC Tech/Internet Working

By Sean González

SATAN and Courtney: A Devil of a Team

Two tools for a proactive approach to Internet security.

Now that the furor over SATAN (Security Administrator Tool for Analyzing Networks) has subsided, has this easy-to-use Internet security tool turned out to be the agent of destruction so many predicted? Not at all. The fact is that, despite SATAN, the Internet continues to flourish. And because of SATAN, more system administrators have finally become concerned about improving their system and network security.

Written by Dan Farmer and Wietse Venema, SATAN is a Unix-based system-auditing tool that can scan any network connected to the Internet, report vulnerabilities to users, and suggest fixes for those vulnerabilities. That SATAN is freely available on the Internet challenges the tradition of restricting security-sensitive information to an administrative elite—what Internet veterans refer to as “security through obscurity.” The reality, though, is that uncovering system and network vulnerabilities is easier through hacker distribution lists and other underground sources than from more reputable ones such as vendors or even Internet security-response teams—making it difficult for honest administrators to gain access to this information.

USING SATAN

To run SATAN, you need a Unix system running SunOS 4.1.3_U1, SunOS 5.3 or Irix 5.3 (though SATAN may work on other Unix systems), Version 5.001 of Perl (a popular Unix scripting language), approximately 3MB of disk space, plenty of memory to speed up processing (SATAN can be a real memory hog if you're analyzing very large networks), and a Web browser.

Because SATAN exploits the familiarity and ease of use of Web browsers, anyone who has used the Web can unleash the power of SATAN in no time. When run interactively, SATAN uses your Web browser as its user interface. You can use the command line interface to automate scans, but to analyze the scan results you need a Web browser.

The SATAN Control Panel (Figure 1) presents an easy-to-follow path to access all features. You start a scan by completing a few simple forms that define a database file for storing the collected data and specify the characteristics of the scan (including which hosts will be probed and how aggressive the scan will be). Depending on your selections and the size of your network, a scan can run from a few minutes to a few hours.

No matter how well you know your network, the scan results are instructive. SATAN reveals information about potentially dangerous network services enabled on each system, highlights security problems, and offers suggestions for eliminating vulnerabilities. And SATAN's powerful analysis extends be-

CUSTOM CONFIGURATION

One of SATAN's most impressive features is the powerful and highly extensible configuration files that allow you to tailor SATAN to work most efficiently in your environment. You can even add new checks to maximize its usefulness. The configuration files govern the behavior of the inference engine, the heart and soul of SATAN.

Three types of files determine SATAN's functionality: the *main configuration file*, the *rulesets files*, and the *probes files*. The main configuration file defines the attack level, time-outs, proximity variables, targeting exceptions, and so forth. This is the file you modify the first time you run SATAN; it's the only file you can modify through a Web form. The rulesets files contain the inferencing rules SATAN uses to determine what is dangerous or potentially harmful as well as what network services are being run. The inferencing engine uses data gathered from each host during a scan to build its security analysis. Some of the rules trigger probes, which are nothing more than executables that test for a given vulnerability. The executables can be any type of code—for example, a Perl script or a C program. Many of the probes are utilities that have been available on the Internet for several years, and users can easily add their own.

KNOWLEDGE IS POWER

The information SATAN provides represents a compendium of years of experience in computer and network security. It contains very detailed explanations of security risks, identifying and fixing problems and even referencing other sources on the Internet. Although much of the information has always been available on the Internet, having it all in one well-organized place makes it very easy to use.

The documentation itself contributed to fears that intruders would use SATAN to uncover security holes and gain unauthorized access to networks. The tutorials are a terrific

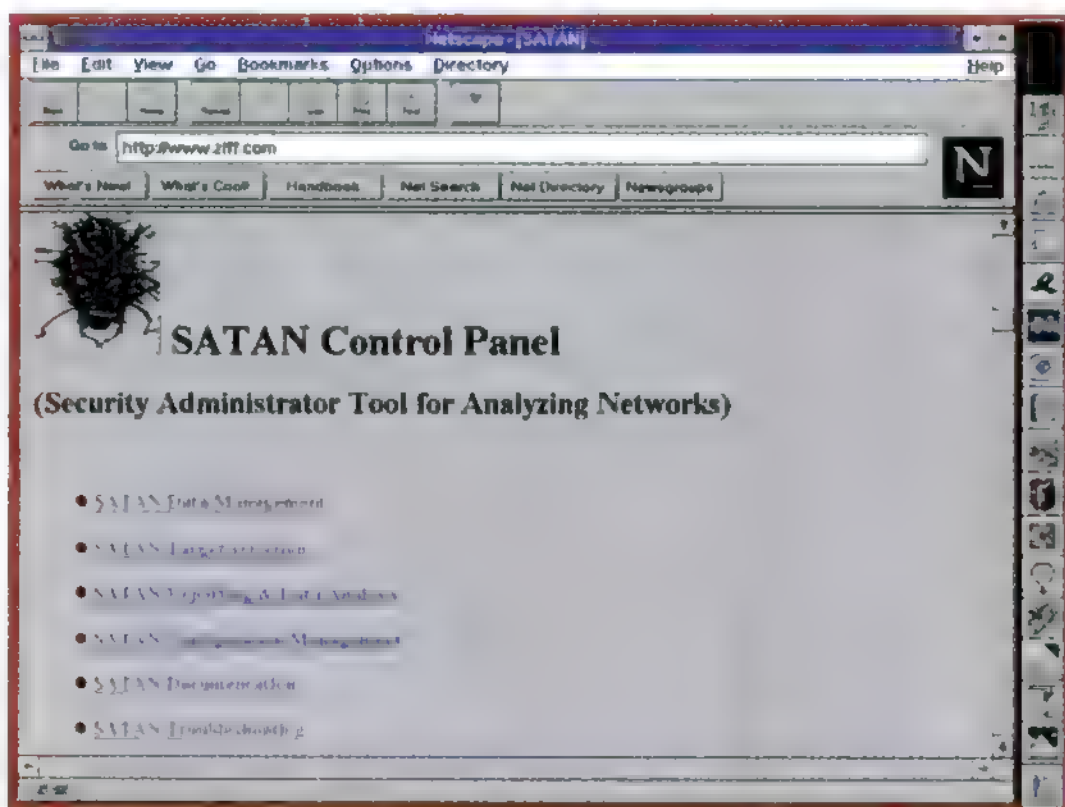


FIGURE 1: Used wisely, SATAN can only benefit the Internet community. This Control Panel presents an easy path for accessing its features.

yond isolated systems and networks by supplying a detailed assessment of security relationships between hosts. For example, assuming host A trusts host B, SATAN will alert you if host B's security can be compromised and, therefore, used to compromise host A's security. Depending on the proximity variable you define, the analysis could extend to hosts C, D, and so on. This evaluation of trust relationships among hosts and networks was central to the authors' objective to develop an intelligent network-security research and analysis tool.

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source of information, with topics ranging from anonymous FTP vulnerabilities to known NFS (Network File System) and NIS (Network Information Services) problems to common system configuration mistakes. And whenever SATAN detects security problems in hosts, each vulnerability it finds is linked to pertinent on-line documentation that explores how an intruder might take advantage of the weakness.

The authors also include an on-line white paper, "Improving the Security of Your Site by Breaking into It," that supplies first-rate information. You can read the paper as a separate document or via the many links to it from SATAN's tutorials on vulnerabilities, which take you to related sections in the paper. As its title suggests, this paper contains specific instructions and commands for exploiting system and network vulnerabilities; it is an invaluable resource for improving security at your site.

THE BEST DEFENSE: COURTNEY

Because SATAN is so good at what it does, a major concern has been that it will do for others exactly what it does for you: direct them to the vulnerabilities in your system and enable them to compromise your site. As a result, other tools—such as Courtney—have been created to defend against such intruders.

Courtney's mission is to detect and report the presence of scanners—programs like SATAN that probe a number of ports on a system in a short time period. The information thus gathered can be used to identify security vulnerabilities.

Courtney, a Perl script, uses a utility called tcpdump to determine whether a scanner has probed a system. Essentially, tcpdump sets the host's Ethernet interface so that the utility can analyze all the TCP/IP packets transmitted on the wire. It then filters the information to highlight suspicious activity and hands this information to Courtney for further analysis. Courtney searches for a specific fingerprint in the data, but unfortunately this isn't always successful, because tcpdump may sometimes relay inaccurate information. Particularly on slow hosts or networks with very high traffic, tcpdump may miss some packets and, therefore, miss the distinctive signature of a scanner. Still, Courtney does provide a first line of defense.

Although many still condemn SATAN because it defies traditional attitudes toward security, at the least this formidable package has successfully heightened awareness of the issues that threaten Internet security. And, used in conjunction with a defensive tool such as Courtney, SATAN can benefit administrators seeking to secure their systems. This in turn can only benefit the Internet community. □



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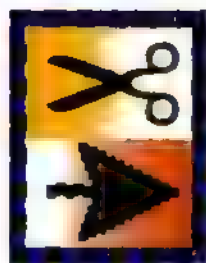
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By Neil J. Rubenking

Practice Safe Setups

Windows programs can add a lot of files and changes to your system: Take control!

Gone are the days when installing a program simply meant copying the .EXE file to your hard disk. Modern Windows applications come with installation programs that create directories, copy files, change your .INI file settings, and generally litter your hard disk with new files. When you want to uninstall a particular program, determining just which files to remove can be nearly impossible. InCtrl2 soothes installation headaches by creating a report file that records all changes made during the installation.

The original InCtrl was released in 1993 and has appeared consistently in *PC Magazine's* Top 10 Utilities list ever since, despite a few limitations. InCtrl2 overcomes those limitations and offers a completely new user interface written in Borland's Delphi. The original InCtrl was limited to tracking no more than 16,380 files; InCtrl2 keeps its tracking information on disk and thus is limited only by disk space. It also offers an optional fast file notification method that avoids the relatively slow process of scanning disk files. The original InCtrl failed if the install program restarted Windows; InCtrl2 survives restart or reboot. Other added features include command line parameters for the install program and user-specified starting directories for disk tracking.

You can obtain InCtrl2 and its source code by downloading the files from CompuServe or the Internet or by mail. See the sidebar "Guide to Our Utilities" for details.

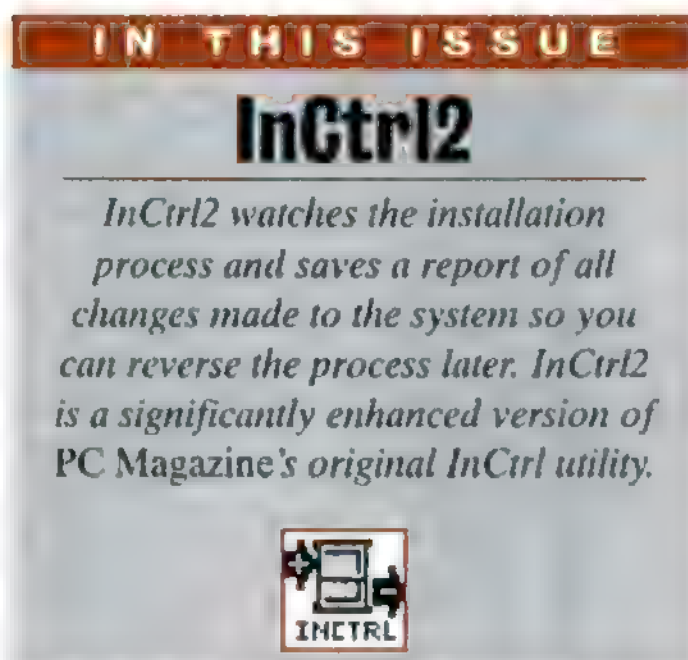
USING INCTRL2

As befits a program that tracks complicated installations, installing InCtrl2 itself is simple: Copy INCTRL2.EXE, INCTRL2.HLP, and FILE-CDRL.DLL to a new directory on your hard disk. You should create a new directory for InCtrl2 because that directory will also be the default location for report files. Add InCtrl2's icon to the Program Manager group of your choice, and you're ready to start tracking installations. To uninstall InCtrl2, delete the three original files and INCTRL2.INI, which is created by the program and stored in the same directory as INCTRL2.EXE. You can also delete any .RPT report files you've created.

Because InCtrl2 is a program you'll use

only occasionally, its interface is styled after the multipage "wizards" and "experts" that save you from relearning how to use a program every time you load it up. Each page asks a question, and InCtrl2 lets you proceed to the next question only when you have provided an appropriate answer. If you're not sure how to answer, help is available for each page at the push of a button or the F1 key.

InCtrl2's first page asks for the name of the installation program (see Figure 1). If you're installing from floppy disks, the installation program will usually be something like



A:SETUPEXE or B:INSTALLEXE. If you're installing from CD-ROM, the program name is still likely to be SETUP or INSTALL, but it will be on the CD-ROM drive. You can enter a name directly or press the Browse button to choose a file using a standard Windows File Open dialog box. You can select a name by browsing, and you can enter any necessary command line switches afterward.

If the name line is left blank, InCtrl2 will operate in two-phase mode. In the first phase, it records all the information it needs to determine what changes were made, and then it quits. You perform the installation, then run InCtrl2 again. In this second phase, it reports on any changes.

When you've entered the full name (complete with three-letter extension) of an existing file, the file type will appear below the name line—for example, "Windows executable" or "DOS batch file." The Next button

is enabled when the name line is left blank or contains a valid executable filename.

On the next page, you enter a descriptive line of text to be included in the report. Remember, it may be months before you look at the report again, so take a moment to enter a description such as "Microsoft Word for Windows 7.0, full install." The Next button is always enabled on this page.

Now you need to choose a name for the output report. The default report file extension is RPT, the default location is the same directory as InCtrl2 itself, and the default name is the first four-digit number not already in use (for example, C:\PCMAG\INCTRL2\0003.RPT). Accept this name by going directly to the next page or press Select to choose a different name or location. The Next button will be enabled as long as you do not attempt to put the output report on a floppy disk or CD-ROM drive.

Next comes the fast file notification page. Fast file notification is a method of detecting changes to the file system. You may have noticed that the Windows File Manager seems to be psychic. As long as you're running Windows in Enhanced mode, File Manager knows right away if you delete or create a file with another application. This is because File Manager calls an undocumented Windows function to get notification of significant file events. InCtrl2's fast file notification takes over this undocumented function for itself. Note that while InCtrl2 is running with fast file notification, File Manager can't get notification; you'll have to press F5 in File Manager to refresh the display as needed. But normally you won't be running File Manager in the midst of installing an application.

The fast file notification page contains a check box for selecting fast file notification. Usually this check box is enabled by default. If it's not enabled, you can press the Explain... button to discover why. There are several obstacles that can prevent InCtrl2 from offering fast file notification:

- The system is not running in Enhanced mode in Windows 3.1.
- The system is running Windows 95.
- The system is running Windows NT.
- InCtrl2 is running in two-phase mode.
- Fast file notification is available, but another program (probably File Manager) is already using it.
- The install program is a DOS executable, and your SYSTEM.INI file doesn't include the line that enables fast file notification for DOS programs.

InCtrl2 has not been tested with OS/2, but it

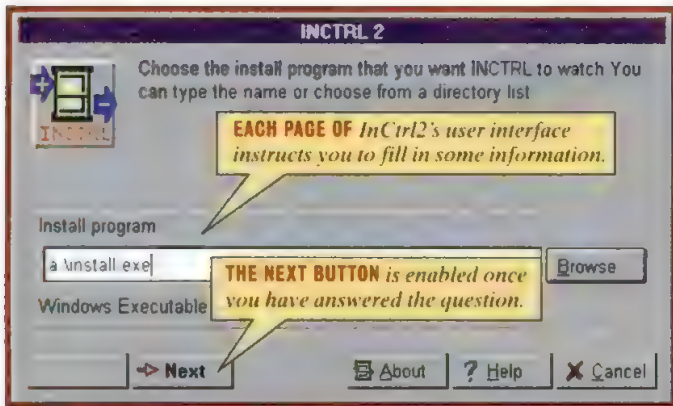


FIGURE 1: InCtrl2's first page.

should work barring idiosyncrasies in OS/2's emulation of Windows.

Fast file notification is disabled when you're running Windows NT, because only file system changes on DOS-compatible FAT (File Allocation Table) drives are reported. Changes to NTFS (NT File System) or network drives under NT are not reported. But since it is quite possible to run Windows NT without using NTFS or a network, InCtrl2 lets you force fast file notification under these circumstances. If you're running Windows NT, press the Explain... button to learn how.

If the problem is that another program is using fast file notification or that your SYSTEM.INI file is missing a line, there's hope. You shouldn't need to run File Manager during an installation, so if it's running, shut it down and restart InCtrl2. If your SYSTEM.INI file is the culprit, change the value of the FileSystemChange= key in the [386Enh] section of SYSTEM.INI to ON. Or add this key if it's not present. Now restart Windows and run InCtrl2 again. (The FileSystemChange=ON line can sometimes slow down disk operations in DOS boxes, so you may want to set it to OFF except when performing DOS-based installations.)

If fast file notification is unavailable, or if you choose not to use it (perhaps because undocumented Windows features make you nervous), InCtrl2 tracks changes to the file system by comparing the contents of your disks before and after the installation. This is the slow-but-steady way to determine which files and directories have changed, and it's the method that the original InCtrl used. It does not involve undocumented Windows features, and InCtrl2 doesn't even have to be running during the installation. When fast file notification is turned off, InCtrl2 creates before and after disk layout files named INCTRL\$.1 and INCTRL\$.2 in its own directory. Be sure you have enough disk space available for the disk layout files; they each require 18 bytes per file or directory

tracked. That doesn't sound like much, but on a hard disk of 500MB or more you can easily have tens of thousands of files. Note that InCtrl2's disk layout files are not meant to be read by humans. Don't modify these files while InCtrl2 is running, or you'll introduce errors into the output report and possibly crash InCtrl2 itself.

When the fast file notification check box is checked, the Next button on the fast file notification page goes straight to the final page. When the box is disabled or unchecked, the Next button takes you to a page that lets you limit the drives and directories tracked (see Figure 2). Recording the disk contents takes time, so you should scan only those drives that could be affected by the installation. You can also restrict the scanning of a given drive to files in and below one particular directory—for example, C:\WINDOWS. If you're installing on a system with network access, it's especially important to limit the tracking to drives that may actually be affected by the installation. And of course you should

enable tracking only for network drives on which you have both read and write access. Although InCtrl2 has been tested successfully on network systems that use both file-tracking methods, it may not be compatible with all network configurations.

Pressing the button that represents a given drive changes the adjacent label from NO to YES, YES to DIR>, or DIR> to NO. When the DIR> state is reached, a directory list for that drive opens, and you can choose a starting directory. Note that you must double-click on a

directory to select it and then click the OK button. If you're using the keyboard, Tab to the button of the drive you want and press the Spacebar to activate the button. To select directories using the keyboard, navigate with the arrow keys and press Enter to open or select the highlighted entry. When you've chosen a directory, Tab to the OK button and press the Spacebar. The buttons for any CD-ROM drives on your system are disabled, since you can't write on a CD-ROM. Removable drives (usually floppy disks) and network drives default to NO; hard disks default to YES.

Let's take a simple example. Suppose you have logical hard drives C:, D:, and E:, and CD-ROM drive F:. Windows resides in C:\WINDOWS, and you intend to install on drive E:. Set drive D: to NO and leave drive E: set to YES. Push drive C:'s button, select C:\WINDOWS, and click OK. That should do it!

The Next button on this page, which is enabled as long as at least one drive is selected for tracking, takes you to the final page, which reports the options you've chosen. Carefully review your settings and, if any are incorrect, press the Prev button to go back

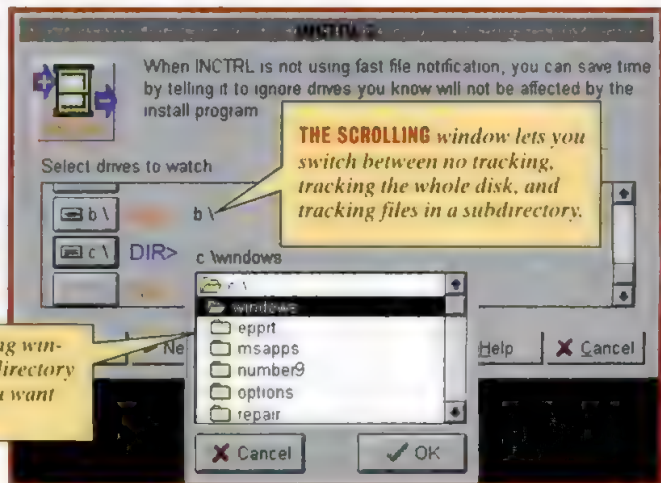


FIGURE 2: The drive/directory selection page.

and make corrections. On the final page, a DO IT! button replaces the Next button. Pressing DO IT! begins the installation process, and InCtrl2 shrinks to a small window that's always on top (see Figure 3). The caption of this small window indicates InCtrl2's current activity—for example, reading files on drive C: or copying SYSTEM.INI. Pressing the small question-mark button will bring up an explanation of what InCtrl2 is doing at the moment.

After InCtrl2 copies WIN.INI and SYSTEM.INI and, if necessary, records the disk layout, it will do one of two things. If you've specified an install program, it will execute that program. You should perform the installation in the

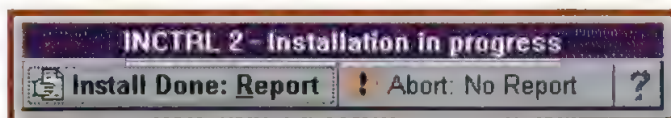
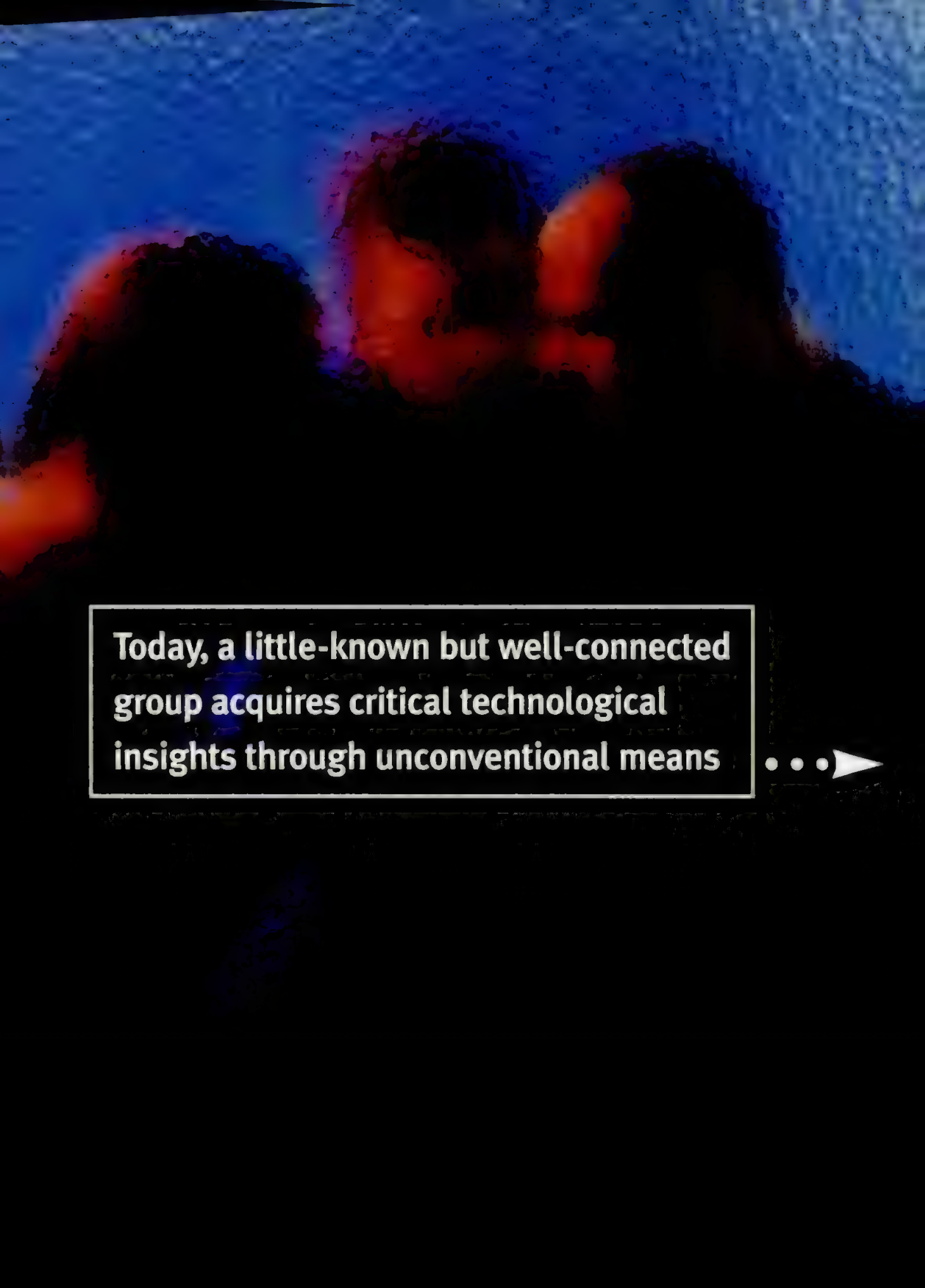


FIGURE 3: While tracking and executing an installation, InCtrl2 shrinks to a small window that's always on top of other windows.



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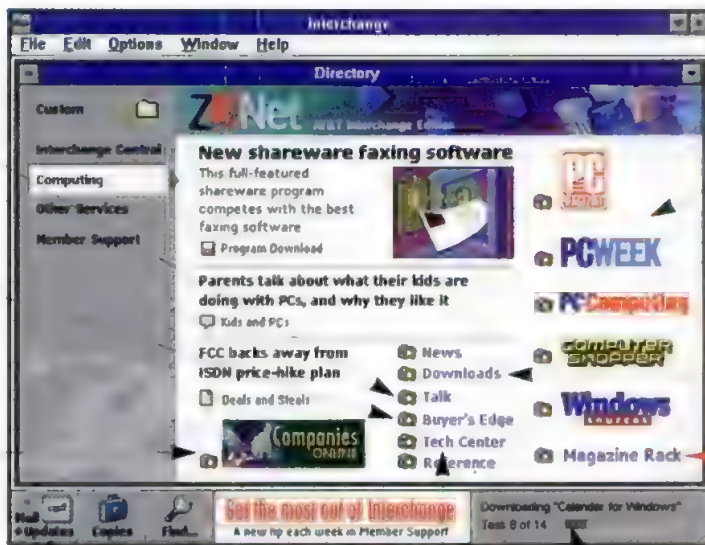
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usual way, pressing InCtrl2's Install Done: Report button when the installation is complete. If you did not enter an install program name on the very first page, InCtrl2 will run in two-phase mode, and it now reminds you of that fact. Shut down InCtrl2, perform the installation, then run InCtrl2 again. It will come up as a small window, just as it does when the install program reboots the system. Press the Install Done: Report button.

The middle button on InCtrl2's small window initially reads Abort: No Install. If you press it, InCtrl2 will clean up its temporary files and shut down without executing the install program. Once preparations are complete and the install program has been launched, you can't call it back, so this button changes to Abort: No Report. Pressing it at this point will terminate InCtrl2 without producing a report on the installation, but you will have to terminate the install program yourself.

When the installation program has finished running and you've pressed the Install Done: Report button, InCtrl2 prepares the installation report. First it compares your system's .INI files with their stored copies and reports any changes. If it used fast file notification, it processes the received file-change data into a useful form and adds it to the report. If it used the disk contents comparison method, it rereads the disk layout and compares this with the original layout, reporting changes. When the report is ready, InCtrl2 previews it for you in a read-only edit box. Close the program when you've skimmed the report; you're done!

Some install programs that add new drivers or change Windows .INI file settings need to restart Windows for the new settings to take effect. If this happens, InCtrl2 simply adds itself to the RUN= line in WIN.INI's [windows]

section and records pertinent information about the ongoing installation in its own .INI file. When Windows restarts, InCtrl2 restarts too.

InCtrl2 has been tested with Windows 3.1, Windows 3.11, Windows for Workgroups 3.11, the test release of Windows 95 current as of this writing, and Windows NT 3.5. It should work with any Windows-compatible network as well. Do note that since InCtrl2 is a 16-bit program, a 32-bit install program could conceivably give it trouble. Also, it can't track the long filenames available in Windows 95 and Windows NT; it will report the DOS equivalents for long filenames. And of course Windows 95 is a "moving target" right now, since it hasn't yet shipped at the time of this writing. Though unlikely, it is possible that the shipping version of Windows 95 will have incompatibilities with the initial release of InCtrl2. Look for a quick update if that happens.

UNINSTALLING PROGRAMS

InCtrl2 does not attempt to uninstall programs for you; rather, it gives you the information necessary for intelligently uninstalling them yourself. InCtrl2's report (see Figure 4) includes a list of all the files and directories that the install program added and a list of sections and keys added to important .INI files. You also get lists of files deleted or changed by the install program and .INI file keys whose values have changed.

Uninstalling does not mean blithely deleting every file added during installation, however. It is possible that you have installed other programs that rely on some of the same files. For example, suppose program Foo installs the file SNAFU.DLL in the Windows System directory. You then install program Bar, which relies on that same DLL—the installation does not change anything, because SNAFU.DLL is already present. If you delete the DLL when uninstalling program Foo, you will disable program Bar.

You can normally delete without worry any files added in a directory created by the install program. But treat files added in a public directory such as the Windows or Windows System directories with more care. Don't delete them; either rename them or move them to a directory not on the PATH. Then try all of your applications to make sure they still work. Or use a program such as *PC Magazine's* FDDLDS utility (described in the Utili-

Installation report: Example report for article
(generated by INCTRL 2)
Tuesday, May 23 04:36 PM
Windows for Workgroups 3.11
Notification by fast file notification

FILES AND DIRECTORIES ADDED: (3)

C:\PCMAG\INCTRL2\NEWDIR
C:\PCMAG\INCTRL2\NEWDIR\F00.DAT
C:\PCMAG\INCTRL2\NEWDIR\BAR.DAT

FILES AND DIRECTORIES DELETED: (1)

C:\PCMAG\INCTRL2\?????????.~??

FILES AND DIRECTORIES RENAMED: (1)

C:\PCMAG\INCTRL2\SCRUGGS.COM TO FLATT.COM

NO CHANGES MADE TO SYSTEM.INI...

CHANGES MADE TO WIN.INI...

SECTIONS ADDED TO WIN.INI: (1)

[NewSection]

KEYS ADDED TO WIN.INI: (2)

[NewSection]NewKey1=foo

[NewSection]NewKey2=bar

KEYS DELETED FROM WIN.INI: (2)

[Extensions]3da=c:\3dchor\3dChor.exe ^.3da

[Extensions]3dc=c:\3dchor\3dChor.exe ^.3dc

KEYS CHANGED IN WIN.INI: (1)

[Desktop]IconSpacing=84 to 75



FIGURE 4: InCtrl2's report includes as much information as possible about the installation. However, it's up to you to use this information wisely when uninstalling programs; take care when deleting added files and .INI file lines.

ties column of December 6, 1994) to see if any other applications reference these public files.

Similar guidelines hold for .INI files. If the install program added a whole new section to WIN.INI, for example, chances are good you can delete that whole section. If it added lines in existing sections, the choice is less clear. Rather than deleting added lines, you should comment them out by putting a semicolon at the start of the line. This way, if a line's absence causes problems, you can restore the line by simply removing the semicolon.

If the install program changed an .INI file key to a different value, don't blindly change it back upon uninstallation. Duplicate the line in the .INI file, comment out the copy, and change the value back. Again, it's possible that program Foo made this change, but program Bar relies on it.

PROGRAMMING INCTRL2

InCtrl2 is not just a port of the original InCtrl, which was written using Borland Pascal and OWL. It uses an entirely new architecture and was written from the ground up in Borland's

THE TOP 10 UTILITIES

- 1 **FDDLDS** Finds dead DLLs
- 2 **SPAD** Enhanced Windows notepad
- 3 **1MBF** Protects low memory
- 4 **FINDIR** Analyzes IRQ lines
- 5 **SCHED** Runs programs automatically
- 6 **WINCMD** Command file interpreter
- 7 **SYSCAP** Captures system information
- 8 **MYGRPS** Customizes group icons
- 9 **WTIME** Keeps PC clock accurate
- PLICON** Places program icons



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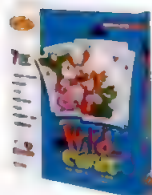
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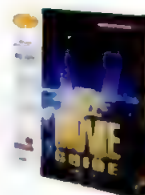
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PROCEDURE SetupDriveButtons;
VAR N : Word;
BEGIN
  {initialize component lists (data fields of TForm1)}
  DriveButtons := TList.Create;
  WatchLabels := TList.Create;
  DirLabels := TList.Create;
  {create temporary drive combo box}
  WITH TDriveComboBox.Create(Self) DO
    try
      Parent := Self;
      FOR N := 0 TO Items.Count-1 DO
        BEGIN
          DriveButtons.Add(TBitBtn.Create(Self));
          WITH TBitBtn(DriveButtons[N]) DO
            BEGIN
              Parent := ScrollBox1;
              Left := 8;
              Top := 8 + N*28;
              Width := 49;
              Height := 25;
              Caption := Items[N][1] + ':\';
              Margin := 4;
              Glyph := Items.Objects[N] AS TBitmap;
              OnClick := DriveBtnClick;
              Tag := N;
            END;
          WatchLabels.Add(TLabel.Create(Self));
          WITH TLabel(WatchLabels[N]) DO
            BEGIN
              Parent := ScrollBox1;
              Left := 64;
              Top := 12 + N*28;
              Width := 40;
              Height := 20;
              Font.Size := 12;
              Font.Style := [fsBold];
              Font.Color := clRed;
            END;
          END;
        END;
      finally
        Free;
      end;
    END;
  END;

```

```

Tag := 0;
Caption := 'NO';
{disable buttons for CD-ROM drives;
 set fixed drives initially to YES,
 removable and network drives to NO}
CASE GetDriveType(Ord(Items[N][1])-
Ord('a')) OF
  DRIVE_REMOVABLE : {do nothing; it's
                    ready}
  DRIVE_REMOTE : BEGIN {network OR CD-
                       ROM}
    IF IsCDRom(Ord(Items[N][1])-Ord('a'))
    THEN
      TBitBtn(DriveButtons[N]).Enabled :=
        False;
    END;
  DRIVE_FIXED : BEGIN
    Caption := 'YES';
    Font.Color := clGreen;
    Tag := 1;
  END;
END;
DirLabels.Add(TLabel.Create(Self));
WITH TLabel(DirLabels[N]) DO
  BEGIN
    Parent := ScrollBox1;
    Left := 112;
    Top := 12 + 28*N;
    Caption := Items[N][1] + ':\';
    Tag := N;
  END;
END;
finally
  Free;
end;
END;

```

FIGURE 5: Creating components at runtime in Delphi isn't difficult, as long as you remember to set the Parent property.

visual programming tool, Delphi.

Astute readers, however, may recognize various techniques and code modules from other utilities and articles of mine. The About Box is almost the same as the one in the recent utilities COA and IconJack. The technique for recognizing significant changes to an .INI file grew out of last year's INIBAK utility (*PC Magazine*, May 17, 1994). I explored the use of the FileCdr function in the Lab Notes article of November 9, 1993. And of course the basic idea of comparing the disk layout before and after an installation was used in the original InCtrl. In the remainder of this article, I will discuss some additional programming techniques that InCtrl2 uses.

CREATING COMPONENTS AT RUNTIME

In most Delphi programs, you lay out components on the form at design time. But there are occasions when you need to create components at runtime—for example, when you don't know how many you will need. The col-

lection of buttons and labels in the scrolling portion of InCtrl2's drive/directory selection page is a perfect example.

The OnCreate event handler for InCtrl2's main form creates a button and two labels for each available drive. For the most part, creating components at runtime is routine, even tedious. Instead of setting the size and position visually and setting other properties using the Object Inspector, you must write a line of code to set each property. One property in particular is crucial; if you forget to include it, your runtime component will not show up on the form. You absolutely must set the Parent property of such a component to point either to the form or to the containing component (panel, notebook page, scroll box) within which the component will reside. In InCtrl2, each component is added to the component ScrollBox1 (see Figure 5). InCtrl2 uses a temporary DriveComboBox to get the list of available drives, and it borrows bitmaps for the buttons from this component.

COMPARING DISK CONTENTS

InCtrl2's disk-contents comparison mode involves a trade-off between speed and required disk space. Storing a full pathname for every file would take a huge amount of disk space. Instead of doing that, InCtrl2 stores the filenames in order within each directory and inserts the contents of a subdirectory immediately after that subdirectory. A prefix character indicating subdirectory depth makes it possible to navigate this list and expand every item to its full pathname as needed. Another character after the filename contains 0 for a file, 1 for a directory. Four more characters hold a string encoded from the file's date/time stamp and size; any change to the file will cause a change in this string.

The grand total is 18 characters per filename. For example, one entry might be 1386SPART.PAR0xxxx.

The initial 1 indicates that this file is in the root directory, and 386SPART.PAR is the name of the file. The 0 after the filename indicates





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that this is a file, not a directory. The last four characters can be anything at all except for the nul, carriage return, line-feed, and end-of-file characters. InCtrl2 uses text files for file layout information, so it needs to avoid those particular characters.

If InCtrl2 needed to track absolutely every change to any file, it would have to use ten characters to store the date/time and size information. That's four characters for the 32-bit date/time value, plus a fifth to identify which (if any) of the four characters was changed because it represented nul, carriage return, line-feed, or end-of-file, and another five characters to represent the 32-bit size in the same way.

XORing the date/time and size information together, however, reduces by a third the bytes needed to track each file. And it's ex-

tremely unlikely that a change to a file would result in a new date/time and size that would give the same result as the old one when XORed together. Since tracking new files is much more important than tracking changes, this trade-off was worthwhile.

Figure 6 shows the code InCtrl2 uses to record files in and below a particular starting directory. The text file OutF is already open and holds a single line containing the starting directory name preceded by 0 (zero). The initial call to FindFiles passes this starting directory, along with the character 1, indicating the first level of subdirectory. FindFiles uses the antiquated FindFirst and FindNext functions to read all hidden, system, directory, and normal files, and it stores their data in an ultramodern sorted string list object. Note that by excluding the volume label attribute, we avoid recording the

extra directory entries used to represent long filenames in Windows NT and Windows 95.

Next, FindFiles iterates through the items in the sorted list, writing each to the output file. If the item represents a subdirectory, FindFiles calls itself, appending the subdirectory to the Dir parameter and increasing the level parameter by 1. FindFiles is a recursive function, and because its output must be sorted in each directory, it must retain on the stack the list of files at each level of recursion. The default stack size for a Delphi program is 8,192 bytes. That's not enough for FindFiles, so InCtrl2's stack size is set to 16,384 bytes.

Finding files that were added, deleted, or changed is a simple matter of comparing the before and after layout files. Unfortunately the CompareDisk method is too large to show here in its entirety (although you can obtain it

```
function DirWMask(const Dir : TFileName) : TFileName;
{Add \.* mask to a directory that may have
 trailing blanks}
VAR P : Byte;
BEGIN
  P := Length(Dir);
  WHILE (P > 0) AND (Dir[P] = ' ') DO
    Dec(P);
  Result := Copy(Dir,1,P) + '\.*';
END;

function StringFor(var vTS : TSearchRec; vLevel : Char) :
String18;
{Create an 18 character string to store info about one
 file.}
const
  vTimeSize : RECORD
    Len : Byte;
    Valu : LongInt;
  END = (Len: 4; Valu: 0);
VAR
  sTimeSize : String[4] ABSOLUTE vTimeSize;
  N : Word;
BEGIN
  vTimeSize.valu := vTS.Time XOR vTS.Size;
  FOR N := 1 TO 4 DO
    CASE sTimeSize[N] OF
      #0, #10, #13, #26 : Inc(sTimeSize[N], $20);
    END;
  Result := Format('%1s%-12.12s%.1x%s',[vLevel,
    vTS.Name, (vTS.Attr AND faDirectory) SHR 4,
    sTimeSize]);
END;

function AddDir(const Dir: TFileName; const Line:
String18): TFileName;
VAR P : Byte;
BEGIN
  P := 13;
  WHILE (P > 0) AND (Line[P] = ' ') DO Dec(P);
  AddDir := Dir + '\' + Copy(Line, 2, P-1);
END;
```

```
procedure FindFiles(const Dir : TFileName; Level : Char);
VAR
  TS : TSearchRec;
  I : Integer;
  TL : TStringList; {local TStringList}
BEGIN
  {Let Windows process messages; Exit if app terminated}
  IF ProcMsgTerminated THEN Exit;
  TL := TStringList.Create;
  try try
    TL.Sorted := True;
    {add file strings to sorted list box}
    I := FindFirst(DirWMask(Dir), faDirectory OR faHidden
    OR
    faSysFile, TS);
    WHILE I = 0 DO
      BEGIN
        IF TS.Name[1] <> '.' THEN
          TL.Add(StringFor(TS, Level));
        I := FindNext(TS);
      END;
    FindClose(TS);
    {write out strings in sorted order; call FindFiles
    recursively for any directories found}
    FOR I := 0 TO TL.Count-1 DO
      BEGIN
        WriteLn(OutF, TL.Strings[I]);
        Result := Result + 1;
        IF TL.Strings[I][14] = '1' THEN
          FindFiles(AddDir(Dir, TL.Strings[I]),
            Succ(Level));
      END;
    finally
      TL.Free;
    END;
  except
    ON E: EInOutError DO
      IF E.ErrorCode <> 6 THEN Raise;
    end;
  END;
```

FIGURE 6: InCtrl2 combines the antiquated FindFirst and FindNext functions with a modern sorted string list object to produce a sorted listing of all files in and below a given directory.




```

{$K+}
LIBRARY FileCdrL;
USES WinTypes, WinProcs;
CONST
  WM_FILESYSCCHANGE = $0034;
  hWndInUse      : hWnd = 0;

FUNCTION FileCdr(FILECDRPROC : TFarProc) : LongInt;
FAR;
  EXTERNAL 'KERNEL' Index 130;

PROCEDURE FileCdrProc(wActionCode : Word; lpszPath :
  PChar);Export;
BEGIN
  SendMessage(hWndInUse, WM_FILESYSCCHANGE,
    Hi(wActionCode),
    LongInt(lpszPath));
END;

FUNCTION FileCdrInstall(H : hWnd) : Bool; Export;
BEGIN
  FileCdrInstall := FALSE;

  IF hWndInUse <> 0 THEN Exit;
  IF NOT Bool(LoWord(FileCdr(@FileCdrProc))) THEN Exit;
  hWndInUse := H;
  FileCdrInstall := TRUE;
END;

FUNCTION FileCdrUninstall(H : hWnd) : Bool; Export;
BEGIN
  FileCdrUninstall := FALSE;
  IF hWndInUse = 0 THEN Exit;
  IF hWndInUse <> H THEN Exit;
  FileCdr(NIL);
  hWndInUse := 0;
  FileCdrUninstall := TRUE;
END;

EXPORTS
  FileCdrInstall      INDEX 1,
  FileCdrUninstall    INDEX 2;
BEGIN
END.

```



FIGURE 7: *InCtrl2 calls on this simple DLL to install and uninstall fast file notification.*

```

procedure TForm1.WMFileSysChange(VAR Msg : TMessage);
{Copy file system change info to temporary file}
BEGIN
  WITH Msg DO
    try
      IF (wParam = 2) OR (wParam = $56) THEN
        WriteLn(FileCdrFile, Format('%.2x%s TO %s',
          [wParam, StrUpper(PChar(lParam)),
            StrUpper(StrEnd(PChar(LParam))+1)]));
      ELSE WriteLn(FileCdrFile, Format('%.2x%s',
        [wParam, StrUpper(PChar(lParam))]);
    except
      ON E:EInOutError DO
        IF E.ErrorCode <> 6 THEN Raise;
    end;
  END;

procedure ProcessLists;
VAR
  N      : Word;
  I      : Integer;
  S      : String;
  Code   : Word;
BEGIN
  TAddS.LoadFromFile(OutPath+TempName+ TempExt1);
  IF TAddS.Count = 0 THEN Exit;
  FOR N := 0 TO TAddS.Count-1 DO
    BEGIN
      S := TAddS[N];
      Code := StrToIntDef('$'+Copy(S,1,2), 0);
      S := Copy(S, 3, 255);
      CASE Code OF
        {DOS, WIN}
        0, $3C, {Create file}
          $5A, {Create unique file}
            {from DOS box, this function comes
              as 0}
          $5B, {Create new file}
            {from DOS box, this function comes
              as 0}
          7, $39, {Create directory}
          $6C : {Extended open}
            {from DOS box, this function is
              ignored}
            TAdd.Add(S);
          1, $41, {Delete file}
          8, $3A : {Delete directory}
            BEGIN
              I := TAdd.IndexOf(S);
              {if we're deleting a file that was
                added...}
              IF I >= 0 THEN
                {...then just don't report it as
                  added}
                TAdd.Delete(I)
              ELSE TDel.Add(S);
            END;
          2, $56 : TCha.Add(S); {Rename file/dir};
          3, $43 : {(Get/set file attrs}
            {no event for GET file attr from a
              WinApp}
          $57 : {(Set file date/time}
            {Schulman mentions this, but it doesn't
              happen}

            END;
          END;
          TAddS.Clear;
        END;

```



FIGURE 8: *The WmFileSysChange method records each file system event in a disk file. When it's time to print a report, the ProcessFiles method takes the list of events and puts them into lists of deleted, added, or changed files.*

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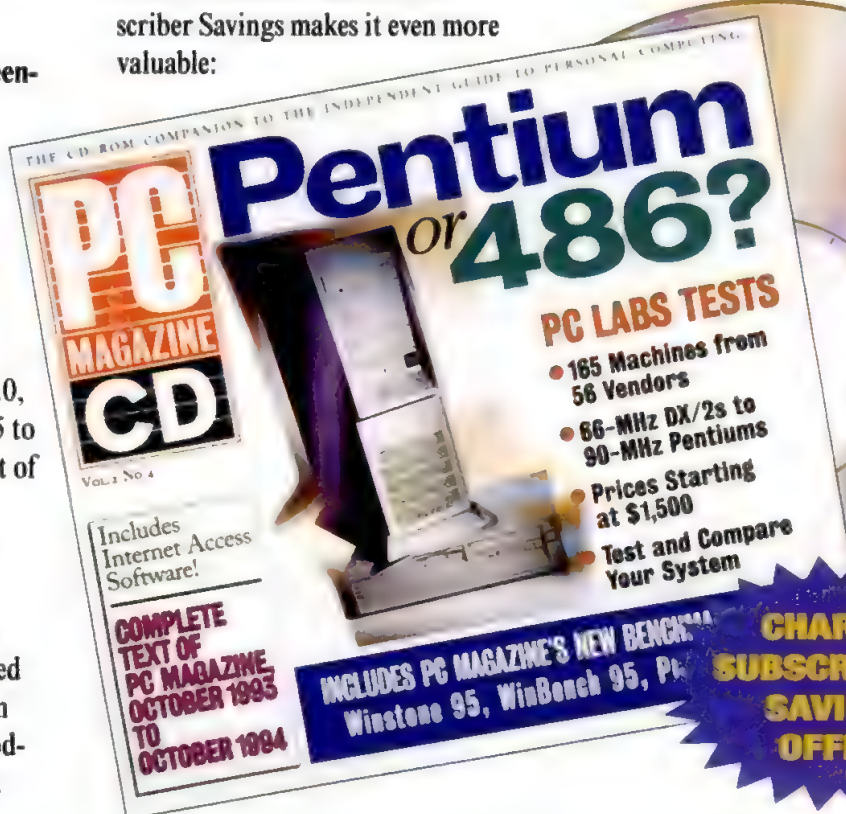
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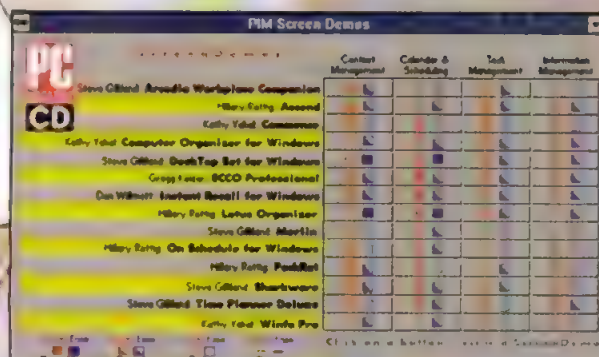
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along with the program); a description will have to suffice. We start by reading one line from each sorted file and comparing the two. If the before line is less, then it represents an item that was deleted. We record it in the deleted list and read another line from the before file. If the after line is less, it represents a file that was added. We record it in the added list and read another line from the after file. If the two lines are the same, we compare their date/time/size data, recording the file as changed if this data doesn't match, and read a new line from both files. We continue reading lines from the before, the after, or both files until we reach the end of both files.

Comparing the two lines is not as simple as $IF\ x > y$. The lines must be split into subdirectory level, name, and date/time/size, and the name must be built up into a complete pathname. The comparison routine first checks the subdirectory levels; if one is deeper than the other, it is reported as the lesser of the two.

If the subdirectory levels are the same, the function returns the result of an ANSI-based comparison of the two strings. Using the ANSI-based comparison is necessary because that's what the sorted TList uses for ordering the names.

FAST FILE NOTIFICATION

The grand finale, the amazing undocumented fast file notification function, is a bit of an anticlimax—it's too easy! Figure 7 shows the entire source code for FILECDRL.DLL, the DLL that connects InCtrl2 to the fast file notification supplied by the FileCdr function. FileCdr is an undocumented Windows function in the Windows Kernel library. You pass it a window handle and the address of a callback procedure; the low word of its LongInt result indicates whether installation was successful.

If the line FileSysChange=ON appears in the [386Enh] section of SYSTEM.INI, tracking of file system changes in DOS boxes is en-

abled. In that case, Windows sends WM_FILESYSCCHANGE messages directly to the window registered with FileCdr. File system changes made by Windows applications trigger the callback function, which in this case simply bundles up the information and sends it off as a WM_FILESYSCCHANGE message. Figure 8 shows the procedure that receives these messages, along with the routine to massage that information into separate lists of added, deleted, and changed files at reporting time. It's as simple as that—but only on systems that support fast file notification.

The original InCtrl has remained popular despite its limitations. InCtrl2 has blasted away some of those limitations, and its two-phase mode should let it work with just about any install program. I hope it will prove even more useful than its predecessor. □

Neil J. Rubenking is technical editor of PC Magazine.

GUIDE TO OUR UTILITIES

Using InCtrl2

DESCRIPTION In addition to placing program files in a new directory, install programs for Windows applications often add files to public directories such as your Windows SYSTEM directory and make changes to your system .INI files. This makes it difficult to fully uninstall Windows programs, and orphaned files will often remain on your hard disk, wasting space.

InCtrl2 watches the installation process and saves a report of all system changes made during installation so you can reverse the process later. InCtrl2 is a significantly enhanced version of PC Magazine's original InCtrl utility.

USAGE To install InCtrl2, place the files INCTRL2.EXE, INCTRL2.HLP, and FILECDRL.DLL in a new directory on your hard disk. You should create a new directory because it will be the default location for reports. You may also want to add a Program Manager icon for InCtrl2.

When you want to install a new program on your system, don't just run its SETUP program. Instead, run InCtrl2 and follow the prompts. On-line help is available throughout the program.

New features include fast file notification, which avoids the time-consuming task of scanning your disk before and after installation; a limitless file-scanning capacity for situations where you cannot use file notification; and the ability to handle install programs that restart Windows. InCtrl2 works with Windows 3.1x, Windows for Workgroups 3.11, Windows NT 3.5, and Windows 95.

FILES FOR DOWNLOAD INCTRL2.EXE—just the files necessary to run InCtrl2 (INCTRL2.EXE, INCTRL2.HLP, and FILECDRL.DLL) in a self-expanding archive.

INCTRL2.DOC—just the documentation file, which you can browse on-line.

INCT2SRC.ZIP—the source code, documentation, and program files.

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PC Solutions

TIPS AND TECHNIQUES TO INCREASE YOUR PRODUCTIVITY

User-to-User

By Neil J. Rubenking

Getting File Sizes

It's often a good idea to check the number of files and the amount of space they occupy within a directory and its subdirectories. You can do this using the `DIR` command with the `/s` switch; the only problem is that this produces pages of output before printing the final result. For example, when I check the size of my `CAWINDOWS` directory, I have to wait for 1,445 lines to scroll by before I can see the end result of "Total files."

Since I do this frequently when cleaning up my hard disk, I decided to try for a batch file solution that would produce only the information I need: total number of files and bytes in a directory and its subdirectories (with a given file specification). When I began, I had no idea how compact a solution I'd come up with.

Say you want the number and the total size of all `.EXEs` within your Windows directory and its subdirectories. Enter the command:

```
dir c:\windows\*.exe /s /w |
  find "bytes" | find /v "free"
  | sort /r | find "bytes" /n |
  find "[1]"
```

Here's what happens:

- `DIR` produces its output, which is piped into `FIND`.
- `FIND` strips off all lines except those containing the word "bytes" and produces output that looks like this:

```
60 file(s) 5,643,473 bytes
1 file(s) 232,184 bytes
...
1 file(s) 1,536 bytes
92 file(s) 13,647,771 bytes
40,091,648 bytes free
```

- Next, `FIND /v` gets rid of the line that gives the

```
@ECHO OFF
dir %1 /-b/s/w | find "file(s)" |
sort /r | find "bytes" /n | find
"[1]"
```

FIGURE 1: The string of DOS commands in this batch file reports the number and size of matching files in and below a particular directory.

bytes-free information, because we're not interested in this. Now the information we need is on the last line of the output.

- At this point, the problem is isolating that last line, and the solution is the `SORT` command: `SORT /r` sorts the output in reverse order. Since the number of files in each directory is the first item on each line, the `SORT` command will place the total (which will always be the greatest value) on the first line. Now the desired information appears at a fixed position—always the first line:

```
92 file(s) 13,647,771 bytes
60 file(s) 5,643,473 bytes
...
1 file(s) 232,184 bytes
1 file(s) 1,536 bytes
```

- The output from `SORT` is piped through `FIND` once more, which looks for "bytes" again, this time tagging each line with its number:

```
[1] 92 file(s) 13,647,771 bytes
[2] 60 file(s) 5,643,473 bytes
...
[13] 1 file(s) 232,184 bytes
[14] 1 file(s) 1,536 bytes
```

- `FIND` comes to the rescue one last time and looks for "[1]," which displays only the first line. The result is a nice and simple:

```
[1] 92 file(s) 13,647,771 bytes
```

You can package the long `DIR`, `FIND`, and `SORT` pipe chain into a single `DOSKEY` macro (called `FS` here), as follows:

```
DOSKEY FS=dir %* /s /w %b find "bytes"
  %b find /v "free" %b sort /r %b find
  %b "bytes" /n %b find "[1]"
```

```
DOSKEY FS=dir %1 /-b/s/w %b find
"file(s)" %b sort /r %b find
"bytes" /n %b find "[1]"
```

FIGURE 2: This batch file creates a `DOSKEY` macro that reports the number and size of matching files in and below a particular directory.

HIGHLIGHTS



HARDWARE Swap the A: and B: assignments of your drives by making a simple hardware switch or with the help of a shareware utility you can download from ZiffNet. Page 288



OPERATING ENVIRONMENTS An inexpensive way to roll your own screen savers from your favorite bitmaps; keep Windows from running at boot-up; make those vanishing program groups stay put. Page 295



DATABASES A reliable technique for determining whether or not a directory exists from within your FoxPro applications. Page 304

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M. David Stone is a contributing editor and coauthor of *Word for Windows Companion, Second Edition*.



PC DIRECT starts here with exciting offers from top direct vendors. See index, page 288

Note the use of the /w switch for wide display. Although it isn't necessary, it produces less output from the DIR command, making execution faster. The temporary files created for piping will also be far smaller, consuming less disk space.

There are a few problems with this method. Sending a /b switch to the FS macro confuses the entire chain of commands since DIR's bare format doesn't include any size information. Also, the macro uses disk space to produce the output, due to temporary files created by DOS for intermediate piping. But if you use a RAM disk, this may not be a problem. Finally, the final output has an extraneous "[1]," which looks ugly. Still, I hope you find it useful.

ATIF AZIZ CHAUDHRY,
Geneva, Switzerland

PC MAGAZINE: It's amazing what you can do simply by stringing DOS commands together! Figure 1 shows a batch file that implements the file-space reporting technique described here. Run it without a parameter and it reports on the current directory and all files in all its subdirectories. Pass it a directory name and it reports on all files in and below that directory. Pass it a file specification like C:\WINDOWS*.EXE and it reports on matching files in and below that directory.

Note that I've added the /b switch to the DIR command. This will override a /b switch passed on the command line or in the DIRCMD environment variable, thus avoiding one potential problem. I also managed to eliminate one call to FIND by initially seeking "file(s)" instead of "bytes."

Figure 2 is a batch file that creates the DOSKEY macro FS. Here too I've introduced the /b switch and eliminated one call to FIND. I also changed \$* to \$!, to make the DOSKEY version behave just the same as the batch file version. In a DOSKEY macro, \$! is replaced by the first parameter, just like %1 in a batch file. The \$* symbol is replaced by all parameters from the command line; there's no equivalent in batch files.

Monitoring Installation Changes

One of the more frustrating aspects of installing Windows applications is that install programs frequently copy files to various locations on your hard disk. If you later decide to uninstall the application, it's often impossible to determine what files are associated with the application. Here's a quick way to identify all files in the Windows directories that an app might add or change during installation.

Just before installing a new Windows app,

run BEFORE.BAT:

```
DIR C:\WINDOWS /S >
C:\BEFORE.TXT
```

Install the application, and then run AFTER.BAT:

```
DIR C:\WINDOWS /S >
C:\AFTER.TXT
FC C:\BEFORE.TXT
C:\AFTER.TXT >
C:\CHANGED.TXT
```

Now start Notepad and load the file C:\CHANGED.TXT. What you'll see is a report

showing every new file in the Windows directories as well as those that changed size or date stamp. Save the report for future reference. While it's true that not every file that was added or changed can be safely deleted, the report will help you see where to start uninstalling.

ANDY JONES, Rockwall, Texas

PC MAGAZINE: This is indeed a handy technique. Using ordinary DOS commands, it generates a useful report on all the changes an application program has made in and below your Windows directory. For each difference FC finds between the two files, it writes out the following:

```
Comparing files BEFORE.TXT and AFTER.TXT
***** BEFORE.TXT
GRYPHON SCR      19,968 07-14-94 12:00a
PICTPREP INI      131 03-22-95  8:59a
***** AFTER.TXT
GRYPHON SCR      19,968 07-14-94 12:00a
NEWFILE EXE      43,072 11-11-93  3:11a
PICTPREP INI      131 03-22-95  8:59a
*****

***** BEFORE.TXT
DELETE LST              0 03-22-95 10:19a
      442 file(s)      27,992,374 bytes

***** AFTER.TXT
DELETE LST              0 03-22-95 10:19a
      443 file(s)      28,035,446 bytes

*****

***** BEFORE.TXT
Total files listed:
      2,190 file(s)    114,428,951 bytes
                        359,333,888 bytes free

***** AFTER.TXT
Total files listed:
      2,191 file(s)    114,472,023 bytes
                        359,628,800 bytes free

*****
```

FIGURE 3: This report resulted from comparing directory listings before and after adding a single file.

```
@ECHO OFF
REM BEFORE.BAT
DIR C:\WINDOWS /S | FIND /V "es" > C:\BEFORE.TXT
```

FIGURE 4: Run BEFORE.BAT in a DOS box just before installing a new Windows program.

```
@ECHO OFF
REM AFTER.BAT
DIR C:\WINDOWS /S | FIND /V "es" > C:\AFTER.TXT
FC C:\BEFORE.TXT C:\AFTER.TXT > C:\CHANGED.TXT
DEL C:\BEFORE.TXT
DEL C:\AFTER.TXT
```

FIGURE 5: Run AFTER.BAT after installing a Windows program, then view CHANGED.TXT to see what changed.

- The name of the first file preceded by five asterisks.
- The last line that matches in both files.
- The different lines from the first file.
- The first matching line after the differences.
- The name of the second file preceded by five asterisks.
- The last line that matches in both files (again).
- The different lines from the second file.
- The first matching line after the differences (again).
- A line of five asterisks.

For example, if the installation added a single file called NEWFILE.EXE, the CHANGED.TXT report would look like Figure 3. The first block of information shows that in BEFORE.TXT there was nothing between GRYPHON.SCR and PICTPREP.INI; afterward NEWFILE.EXE appeared between them.

Unfortunately, the remainder of the information in the report isn't useful, and in a real installation with many files it could obscure the important changes. It's obvious that when files are added the number of files and total bytes will change; we don't need that information. It makes sense to eliminate the useless lines from the report. As it happens, all of the useless lines contain the string "es" in lowercase letters, within the word "bytes" or "files." Filenames never contain lowercase letters. Thus we can use the FIND/V command to filter out any lines containing "es." Figures 4 and 5 are versions of BEFORE.BAT and AFTER.BAT that incorporate this enhancement. Now when FC reports on changes, it will only report changes that are important.

For a full-featured Windows program that tracks installations, see this issue's Utilities column, "Practice Safe Setups."

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SONY CDU-55S Dual Speed SCSI	220ms access, 300Kb/sec transfer					
SONY CDU-55S Dual Speed IDE	220ms access, 300Kb/sec transfer					
NEC 3Xp SCSI	240ms access, 500Kb/sec transfer					
TEAC CD-55 QuadSpeed IDE	195ms access, 600Kb/sec transfer					
NEC 4X SCSI	220ms access, 600Kb/sec transfer					
4Plex SCSI	235ms access, 600Kb/sec transfer					
QUAD SPEED SCSI	120ms access, 600Kb/sec transfer					
6Plex SCSI	145ms access, 900Kb/sec transfer					
6Plex SCSI						

SCSI ADAPTERS

Model	Capacity	Interface	Seek	RPM	Cache	Int.
ADAPTEC 280A	280ms access, 300Kb/sec transfer					
ADAPTEC 280B	220ms access, 300Kb/sec transfer					
ADAPTEC 280C	220ms access, 300Kb/sec transfer					
ADAPTEC 280D	220ms access, 300Kb/sec transfer					
ADAPTEC 280E	220ms access, 300Kb/sec transfer					
ADAPTEC 280F	220ms access, 300Kb/sec transfer					
ADAPTEC 280G	220ms access, 300Kb/sec transfer					
ADAPTEC 280H	220ms access, 300Kb/sec transfer					
ADAPTEC 280I	220ms access, 300Kb/sec transfer					
ADAPTEC 280J	220ms access, 300Kb/sec transfer					

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MODEMS

Model	Capacity	Interface	Seek	RPM	Cache	Int.
Robotics 95/110	280ms access, 300Kb/sec transfer					
Robotics 224/242	220ms access, 300Kb/sec transfer					
Robotics 335	220ms access, 300Kb/sec transfer					
Robotics 375/445	220ms access, 300Kb/sec transfer					
Robotics 375	220ms access, 300Kb/sec transfer					
Robotics 435	220ms access, 300Kb/sec transfer					
Robotics 435	220ms access, 300Kb/sec transfer					
Robotics 435	220ms access, 300Kb/sec transfer					
Robotics 435	220ms access, 300Kb/sec transfer					
Robotics 435	220ms access, 300Kb/sec transfer					

OPTICAL DRIVES

Model	Capacity	Interface	Seek	RPM	Cache	Int.
FUJITSU 2230 MB SCSI	2230 MB	SCSI	30ms	525	585	
FUJITSU 2230 MB PC	2230 MB	PC	30ms	n/a	725	
FUJITSU 2230 MB SCSI	2230 MB	SCSI	30ms	n/a	725	
FUJITSU 2230 MB SCSI	2230 MB	SCSI	30ms	2195	2295	
FUJITSU 2230 MB SCSI	2230 MB	SCSI	30ms	2295	2395	

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SCANNERS

Model	Capacity	Interface	Seek	RPM	Cache	Int.
Nikon Scantouch	280ms access, 300Kb/sec transfer					
Nikon Transparency Adapter	220ms access, 300Kb/sec transfer					
Nikon Super Coolscan	220ms access, 300Kb/sec transfer					
UMAX UC630/1260	220ms access, 300Kb/sec transfer					
UMAX Vista-56	220ms access, 300Kb/sec transfer					
UMAX Powerlook	220ms access, 300Kb/sec transfer					

SCSI HARD DRIVE CABINETS

Model	Capacity	Interface	Seek	RPM	Cache	Int.
Deskpro 3.5"	280ms access, 300Kb/sec transfer					
Minicab 3.5"	220ms access, 300Kb/sec transfer					
Full Height Cab	220ms access, 300Kb/sec transfer					
Multi Bay Cabinets	220ms access, 300Kb/sec transfer					

SCSI & IDE HARD DRIVES

Seagate

Model	Capacity	Interface	Seek	RPM	Cache	Int.
Hawk 2LP	1.2 GB	SCSI	9.5ms	5400	512K	\$495
Hawk 4	4.2 GB	SCSI	9ms	5400	512K	1165
Barracuda	2.4 GB	SCSI	8ms	7200	1024K	970
Barracuda	4.2 GB	SCSI	8ms	7200	1024K	1429
Barracuda Wide	2.4 GB	SCSI	8ms	7200	1024K	1115
Barracuda Wide	4.2 GB	SCSI	8ms	7200	1024K	1545
Elite	9.0 GB	SCSI	11ms	5400	512K	2350
ST3491A	420 MB	IDE	14ms	3800	120KB	160
ST3660A	540 MB	IDE	14ms	3800	120KB	170
ST3850A	850 MB	IDE	12ms	4500	120KB	230
ST31220A	1.2 GB	IDE	12ms	4500	120KB	295

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Amquest 28.8bps internal V.34 fax/modem	\$175.00
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CONNER

Model	Capacity	Interface	Seek	RPM	Cache	Int.
CFP1060	1.06 GB	SCSI	10ms	5400	256K	415
CFP2105	2.0 GB	SCSI	8.5ms	5400	512K	855
CFP2107	2.1 GB	SCSI	8.5ms	7200	512K	925
CFP4207	4.2 GB	SCSI	9ms	7200	512K	1199
CFS425	425 MB	IDE	14ms	3400	64KB	155
CFS540	540 MB	IDE	14ms	3600	64KB	175
CFS850	850 MB	IDE	14ms	3600	64KB	235
CFS1275	1.2 GB	IDE	14ms	3600	64KB	330

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Quantum

Model	Capacity	Interface	Seek	RPM	Cache	Int.
Trailblazer	420 MB	IDE/SCSI	11ms	4500	128K	155/170
Fireball	540 MB	IDE/SCSI	10ms	5400	128K	180/185
Lightning	730 MB	IDE/SCSI	11ms	4500	128K	215/245
Trailblazer	850 MB	IDE/SCSI	11ms	4500	128K	235/270
Fireball	1080 MB	IDE/SCSI	10ms	5400	128K	365/395
Atlas	2.1 GB	SCSI	8ms	7200	1024K	879
Grand Prix	4200 MB	SCSI	8.6ms	7200	512K	1055
Atlas	4.3 GB	SCSI	8ms	7200	2048K	1415

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WD2540A	540 MB	IDE	11ms	4500	64KB	190
WD2850A	850 MB	IDE	10ms	4500	64KB	230
WD3120A	1.2 GB	IDE	10ms	4500	64KB	340
WD3180	1.6 GB	IDE	10ms	4500	64KB	595

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Model	Capacity	Interface	Seek	RPM	Cache	Int.
M4221	2.1 GB	SCSI	8.5ms	7200	512K	865
M1998	3.6 GB	SCSI	11ms	5400	512K	1225
M3243	4.3 GB	SCSI	8.5ms	7200	512K	1295
M1991	9.0 GB	SCSI	11ms	5400	512K	2095
M4221Wide	2.1 GB	SCSI	8.5ms	7200	512K	965
M3243Wide	4.3 GB	SCSI	8.5ms	7200	512K	1395
M1991Wide	9.0 GB	SCSI	11ms	5400	512K	2195
M4221AV	2.1 GB	SCSI	8.5ms	7200	512K	915
M1998AV	3.6 GB	SCSI	11ms	5400	512K	1275
M3243AV	4.3 GB	SCSI	8.5ms	7200	512K	1465
M1991AV	9.0 GB	SCSI	11ms	5400	512K	2295

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Model	Capacity	Interface	Seek	RPM	Cache	Int.
M2100	2.1 GB	SCSI	8.9ms	7200	512K	5 Year
M4300	4.3 GB	SCSI	8.9ms	7200	512K	5 Year

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Model	Capacity	Interface	Seek	RPM	Cache	Int.
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270 MB IDE	270 MB	IDE	13.5ms	3200		420 n/a
Com. 125						
44 MB	SQ400					41
88 MB	SQ800					47
105 MB	SQ10					53
200 MB	SQ2000					75
270 MB	SQ327					63

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Etherlink III-S	478/527					
Etherlink III-20	Call					
Etherlink III	225					
Etherlink III	225					
Etherlink III	110					
Etherlink III	65					
CCNPS	268					
CCNPS Combo	298					
CCNPS Token Ring	434					
Pocket III	268					
Parallel Port	77					
BEN210	135					
BEN220	265					

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Model	Capacity	Interface	Seek	RPM	Cache	Int.
250 MB IDE Jumbo 350 QIC 80						\$149 n/a
250 MB IDE Jumbo 350 QIC 80 Parallel						n/a 275
350 MB IDE Jumbo 350 QIC 80						\$189 n/a
350 MB IDE Jumbo 350 QIC 80 Parallel						n/a 285
700 MB IDE Jumbo 350 QIC 3010 Parallel						n/a 325
1.4 GB (1) Jumbo 1400 QIC 3010						\$399 n/a
1.05 GB SCSI Powerbase 1100 QIC525						\$599 699
2.0 GB 15MB/sec 4mm media						\$835 \$885
3-5 GB 24MB/sec 4mm media						995 1055
4-10 GB 48MB/sec 4mm media						1225 1285
20-30 GB Auto Tape Loader						3195 3295

CONNER

Model	Capacity	Interface	Seek	RPM	Cache	Int.
420 MB IDE	420 MB	IDE				\$175 n/a
850 MB IDE	850 MB	IDE				\$260 n/a

EXA BYTE

Model	Capacity	Interface	Seek	RPM	Cache	Int.
2 GB SCSI	2 GB	SCSI				845 955
4 GB SCSI	4 GB	SCSI				995 1095
2-5 GB SCSI	2-5 GB	SCSI				1425 1495
7-14 GB SCSI	7-14 GB	SCSI				2250 2310

Mountain

Model	Capacity	Interface	Seek	RPM	Cache	Int.
350 MB TO-80 QIC 80 IDE						310 n/a
700 MB TO-80 QIC 80 IDE						475 n/a
1.0 GB MTN1000 4mm media SCSI						1675 1775
4.0 GB MTN2000 4mm media SCSI						1945 2045

Quantum DLT SCSI

Model	Capacity	Interface	Seek	RPM	Cache	Int.
DLT2000X 30GB	30GB	SCSI	2.5MB/sec	DLT20		\$295
DLT4000 40GB	40GB	SCSI	3MB/sec	DLT40		\$295

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Ask Our Advisors

HARDWARE

Disk Dilemma

 I recently purchased a new IDE hard disk to use as the second drive on my computer. In an attempt to avoid compatibility problems, I made sure the new disk was from the same manufacturer as the old one. Nevertheless, despite hours on the phone with tech support, I still can't get the new drive to work reliably as a slave with the original as the master drive. It takes an hour to write 1MB of data from the original disk to the new drive, but less than a minute to write the same data back again.

One of the technicians suggested I make the original drive the slave and the new drive the master, but I'm afraid that might void the warranty on my nearly new computer. I don't have any documentation on the original drive, and I'm reluctant to disconnect the drive from its mounting hardware in order to get at its jumpers.

Am I wrong to worry about the warranty, and do you think that changing the jumpers on the original drive might solve the problem? I don't think I'm being unreasonable in expect-

ing two drives from the same manufacturer to work together.

CYRUS J. STOWE, Conyers, Georgia

PC MAGAZINE: You certainly should expect these two drives to work together, but possibly you're being overly cautious about working on your system.

Your first step should be to contact the makers of your computer system. Not only might they be able to provide you with the jumper settings you need, but they certainly would be able to tell you exactly what you can and cannot do to your system under the warranty coverage. (You should have received this information in writing with the system, but it never hurts to verify the specifics.) I'd be extremely surprised to find that removing the hard disk from its mounting or changing its jumpers would affect your coverage, but again, it doesn't hurt to ask.

It is indeed very likely that incorrect jumper settings on the original drive are the source of your problems. An IDE drive can be set up as either the master or the slave; the master is responsible for providing the controller functions for both drives.

What users often don't realize, however, is that many IDE drives have not two, but three different possible settings. In addition to the slave setting, there are often two separate master settings. One is used for a master drive in a system with only one hard drive, and the other is for a master when a slave is present. I suspect that in this case your original drive is set as master-only and needs to be changed to master with slave. If you don't have the documentation for the original drive, the manufacturer can provide the jumper settings for you; many manufacturers operate bulletin board and fax-on-demand systems to provide such information.

If you're hesitant to make the changes yourself, the manufacturer can likely refer you to a qualified repair service in your area that can change the configuration for you. While this service will cost something, the result will be a useful disk drive that doesn't take an hour to copy a megabyte of data.—*Alfred Poor*

Floppy Drive Assignments

I'm trying to set up an old 386 system for my mother and I want to install new software, starting with an up-to-date version of DOS. Un-

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INDEX

SYSTEMS

AMS322
CompUSA336
COMPUTER DISCOUNT
WAREHOUSE326
Ergo Computing, Inc.296
HARTFORD COMPUTER GROUP ..289
INSIGHT DIRECT, INC.324, 368
Magitronic309
Midwest Micro Peripherals331
MPC Technology301
PCs Compleat314
PerComp Microsystems, Inc.298
USA Flex318

SOFTWARE/PERIPHERALS/
COMPONENTS
ARLINGTON COMPUTER
PRODUCTS310

COMPUTER DISCOUNT

WAREHOUSE326
First Source International290
HARTFORD COMPUTER GROUP ..289
INSIGHT DIRECT, INC.324, 368
LA Trade302
Megahaus335
Micro Solutions305
MicroMall Direct297
Micron Computer, Inc311
Midwest Computer Works306
PC Connection320
PC Mall312
Pro Direct287
SPSS, Inc.330
Sunshine Computers294

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288 PC MAGAZINE SEPTEMBER 26, 1995



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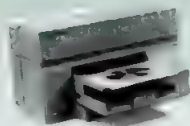
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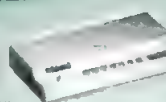
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*TMM400M DX4/75 455 Act 8.4" Disp	2447.05
*TMM400M DX4/75 455 Dual 10.5" Disp	2229.05
*TMM400M DX4/100 524 Act 9.5" Disp	3205.89
*TMM400M DX4/100 524MB Act 10.5" Disp	3485.11
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XV17 17"	783.00	XP17 17"	1046.40
XE15 15"	548.27	XP21 21"	2188.72
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LQ300	179.55	Stylus 1000	468.20
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3626	403.43	3123	247.59
2023	179.82	4400Laser	449.88
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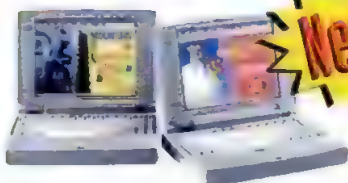
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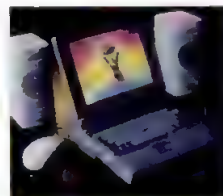
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- 10.4" display
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- Lithium Ion battery
- Built-in sound



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T2130CS	486DX4/75	8MB	10.4" Dual Scan	500MB	\$2,418
T2130CT	486DX4/75	8MB	10.4" Active	500MB	\$3,014

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- Built-in sound



Model	Processor	Ram	Screen	Hard Drive	Price
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910N	486DX4/75	8MB	10.4" Active	510MB	\$3,071
910N	486DX4/75	8MB	10.4" Active	700MB	\$3,258
950N	Pentium/75	8MB	10.4" Dual Scan	500MB	\$3,258
950N	Pentium/75	8MB	10.4" Dual Scan	800MB	\$3,537
950N	Pentium/75	8MB	10.4" Dual Scan	1.2GB	\$4,003
950N	Pentium/75	8MB	10.4" Active	800MB	\$4,654
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4000M	486DX4/75	4MB	10.4" Active	525MB	\$2,699
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- Infrared data transfer



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Versa 4000D*	Pentium 75	8MB	10.4" Dual Scan	540MB	\$3,579
Versa 4000C	Pentium 75	8MB	10.1" Active	540MB	\$3,999
Versa 4050C*	Pentium 90	8MB	10.1" Active	810MB	\$4,776
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NEC



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Versa 2000C*	486DX4/75	8MB	9.5" Active	350MB	\$2,420
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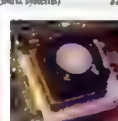
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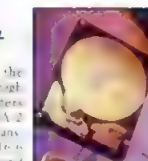
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Epson ActionLaser 1100	2MB n/a	\$99	4MB n/a	\$159
Epson ActionLaser 1600	4MB n/a	\$159	16MB n/a	\$609
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HP LaserJet II, IID	2MB 33444B	\$95	4MB 33445B	\$169
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	4MB C2065A	\$169	8MB C2066A	\$339
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Okidata 400e, 410e	2MB n/a	\$117	4MB n/a	\$197
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fortunately, I can't boot from the 3.5-inch setup disk, because the computer has a 5.25-inch drive A:. I tried changing the computer's CMOS configuration settings so that the 3.5-inch drive would be assigned as drive A:, but that didn't work. Do I have to change some jumpers on the drives themselves?

SCOTT GRAY, via ZiffNet

PC MAGAZINE: Actually, you can solve your problem simply by changing the cable connections. The floppy controller cable will have connectors; swap the connectors with the two drives and the drive assignments should change with them.

Some computers now come with a dual floppy drive, which combines a 5.25- and a 3.5-inch drive in a single half-height housing. These typically have a jumper you can set to determine which drive is assigned as drive A:. You don't have to change this jumper in most cases, however; by plugging the combination drive into the first or second connector on the floppy cable, you can control which drive is drive A: and which is drive B:. Don't forget, though, that you still should change the CMOS settings to match the configuration you have physically selected for the two drives.

If your only reason for needing to boot from the A: drive is to install DOS, you might prefer a software solution. BOOT-B, a shareware utility you can download from ZiffNet (Tips Forum/Library 3), lets you boot from your B: drive. You put a disk with BOOT-B installed into drive A:, and the system will then boot from the B: drive.—*Alfred Poor*

OPERATING ENVIRONMENTS

Roll Your Own Screen Savers



Is there any way I can create screen savers from my own bitmaps? I'd like to take bitmaps (pictures or reminder notes) and convert them into a screen saver file, then have them cycle so I'd see a different note or picture every time my screen saver kicks in.

KORY KOEVEN, Montpelier, Idaho

PC MAGAZINE: The \$39 utility Private Screening, from MicroSeconds, does exactly what you've asked for and more. It will incorporate any combination of bitmaps, Photo-CD pictures, video clips, and sounds into a unique screen saver. Private Screening comes with a CD-ROM containing hundreds of bitmap images and dozens of video clips and sounds to get you started. It handles cycling through your images too, so you won't need a separate product for that. As an added bonus, you can generate a complete distributable screen saver on disk, with up to 20 images, to give to friends or business associates. The one possi-

ble drawback is that Private Screening currently requires a CD-ROM drive, though a disk-based version is in the works. For more information, contact MicroSeconds at 800-889-3279.

Our GUIToons utility also lets you produce screen savers from your own bitmaps, although with fewer features.—*Neil J. Rubenking*

Control AUTOEXEC.BAT at Boot Time

I usually run Windows, and I load it at boot-up with the WIN command in my AUTOEXEC.BAT. But sometimes I'd like to boot without running Windows, leaving everything else just the same. Is there a way I can avoid running Windows just by pressing the Shift key at boot time?

JON LEFFERT, Edina, Minnesota

PC MAGAZINE: You can indeed control batch file execution by holding down a Shift key. Redirect the script from Figure 6 into DEBUG using the command DEBUG < SHIFTKEY.SCR. This will produce a tiny program named SHIFTKEY.COM. SHIFTKEY sets the DOS exit code (errorlevel) to a nonzero value if you press either Shift key while it runs. To set up your AUTOEXEC.BAT so it skips running Windows when you're holding down the Shift key, end it with lines like these:

```
SHIFTKEY
IF ErrorLevel 1 GOTO NoWindows
CD\WINDOWS
WIN
:NoWindows
```

Don't start holding the Shift key until you see AUTOEXEC.BAT begin processing. In DOS 6.0 and later, your system will entirely skip processing CONFIG.SYS and AUTOEXEC.BAT if you're holding Shift early in the boot process, when the "Starting MS-DOS..." message appears.

```
N SHIFTKEY.COM
A 100
MOV AX,40
MOV DS,AX
MOV AX,[17]
AND AX,3
MOV AH,4C
INT 21

RCX
10
W
0
```

FIGURE 6: This DEBUG script produces a tiny program that sets the errorlevel to a nonzero value when a Shift key is pressed.

If you do use DOS 6.0 or later, however, you may appreciate a more modern solution, one that doesn't require you to lean on the Shift key while AUTOEXEC.BAT is loading. Insert these lines at the very start of your CONFIG.SYS file:

```
[menu]
menuItem=YesWin,Windows
menuItem=NoWin,No Windows
menuDefault=YesWin,10
[YesWin]
[NoWin]
[Common]
```

When you boot up, you'll get a menu with two items, Windows and No Windows. Your choice doesn't affect the processing of CONFIG.SYS, because the individual menu blocks are empty. Whichever you choose, the lines in the Common block get processed just as if you hadn't added the menu.

The point of this exercise is that the environment variable CONFIG gets set to the name of the chosen menu item. You can use this fact to control whether or not Windows gets loaded in AUTOEXEC.BAT:

```
IF '%CONFIG%'=='NoWin' GOTO NoWindows
CD\WINDOWS
WIN
:NoWindows
```

And you don't have to sit around with your finger on the Shift key!—*Neil J. Rubenking*

Disappearing Program Groups

Recently I switched drivers and everything has been working great, except when I create a program group or install a program that creates a group—the group exists only during that Windows session. When I restart Windows, all of the new groups have disappeared and I have to re-create them. But the groups created before I switched drivers are still there. I even tried returning to the old drivers, but that doesn't work. What should I do?

JOHN CLARK, via the Internet

PC MAGAZINE: I doubt your drivers are the source of the problem. From the symptoms, I would guess you've set the file PROGRAM.INI to be read-only. People often make their AUTOEXEC.BAT and CONFIG.SYS files read-only to avoid accidental changes. Although .INI files are as important to Windows as those two start-up files are to DOS, you must not try to protect them in the same way. Windows .INI files are constantly changing. If they're read-only, necessary changes don't get stored. In Windows 3.1, you get a warning at start-up if PROGRAM.INI is read-only.

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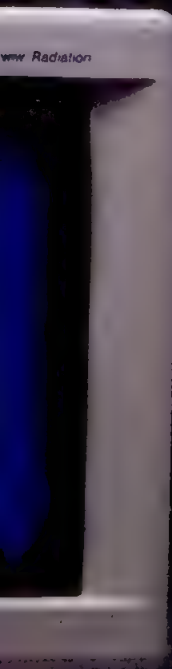
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What's the solution? Easy. Highlight **PROGMAN.INI** in File Manager and press Alt-Enter or select Properties from the File menu. The resulting dialog has check boxes for four different file attributes. Remove the X from the Read Only check box and press OK. Now your group window changes and additions should stick.—Neil J. Rubenking

WORD PROCESSING

Professional-Looking Equations in WordPerfect



I often need to stack a superscript and a subscript vertically to form specialized symbols, such as those shown in the top row in Figure 7. The WordPerfect equation editor permits the stacking easily enough, but the results are often less than professional-looking.

To produce equation (1), for example, you enter

```
{'}_92^238 Func U
```

in the equation editor's Type Equation Text box. The backquote and curly braces are

needed whenever the first character would otherwise be the subscript or superscript command. The underline is the subscript command, and the caret is the superscript command. The Func command removes the default italics from the U.

The text for (2) is

```
Func H_51^23
```

And the text for (3) is

```
{'}_{DELTA Q}^51 F_xh^51
```

There are visible problems with all three equations. In (1), the subscript and superscript are left-aligned when they should be right-aligned. Trying to align them properly by typing a space before the 92 doesn't work; WordPerfect ignores the space. In (2), the

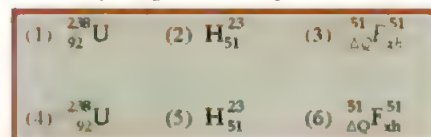


FIGURE 7: The WordPerfect equation editor makes it easy to build equations with vertically stacked superscripts and subscripts, as in the three equations across the top. But a little work is required to make them look like the three in the second row.

subscripted text starts so noticeably to the left of the superscripted text that it actually touches the H. In (3), I'd like to get rid of the italics. But depending on where I put the Func command, WordPerfect either complains about a syntax error (when the Func command is just before the subscript command) or applies the command to only part of the equation. If the Func command is at the very beginning, for example, WordPerfect removes italics from the Q only. Is there a way to solve these problems?

ROBERT BROWN, San Francisco, California

PC MAGAZINE: WordPerfect's equation editor can be a little frustrating, both because its defaults don't always give you the format you're most likely to want and because the commands don't always work the way you might expect. The problems in equations (1) and (2) fall into the first category; equation (3) falls into the second.

The easy way to fix the problems in (1) and (2) is to add spaces, but if you simply type in a space, WordPerfect ignores it. The equation editor provides a space command you can use instead. In fact, it offers two commands: a tilde for a full space and a backquote for a thin (one-quarter-width) space.

To turn equation (1) into equation (4), you need to add space commands before the 92. If

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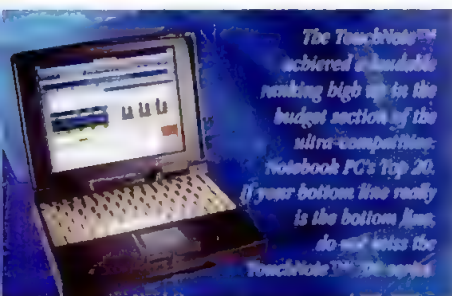
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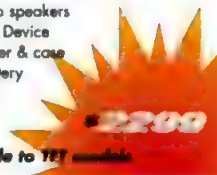
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you simply enter the space commands, however, WordPerfect will no longer treat the 92 as a subscript. The solution is to use curly braces to group the space commands and the 92 together. As it happens, you need to adjust this particular equation by one and a quarter spaces. So the final version is

```
{'}_{~'92)^238 Func U
```

Similarly, to turn equation (2) into equation (5), you need to add two quarter spaces, so the text becomes

```
Func H_{''51})^23
```

Even fixing equation (3) is less complicated than it might seem. The DELTA is the command for the uppercase Greek letter delta. The curly braces around the DELTA and the Q group the two characters together, so the subscript command will apply to both. To apply the Func command to the entire equation, you must put curly braces around the original version of the text as it stands and then put the Func command at the beginning. In my tests, I found I also had to adjust the spacing slightly, so the version that produced equation (6) is

```
Func({'')_{DELTA Q)^51{'')F_{''xh)^51}
```

One last note is in order. I first ran these tests in WordPerfect for DOS, then loaded the file into WordPerfect for Windows 6.1. Surprisingly, in equations (3) and (6) in Windows, the superscripts and subscripts on the right side of the equation were lower than the superscripts and subscripts on the left.

A little investigation showed that the problem disappeared when I changed the equation font. (You can change fonts within the equation editor by choosing Font | Equation Font.) In fact, the only fonts I found that exhibited this problem were Courier New, WP Arabic Sihafa, and WP ArabicScript Sihafa.

If you run into this problem and can't use a different font, the only workaround is rather clumsy. First, you must add Vert and Horz commands to adjust the vertical and horizontal placement of the characters. To use Vert commands, however, you must delete the superscript and subscript commands. That means you also have to add ScaleSym commands to scale the characters down to superscript and subscript size. The equation then becomes

```
Func({'')_{DELTA Q)^51{'')F
Vert -28 ScaleSym 70xh
Vert 80 Horz -82 ScaleSym 70 51}
```

The numbers after the Vert, Horz, and ScaleSym commands are percentages of the font size, so a ScaleSym 70, for example, re-

duces the character to 70 percent of its normal size. Clearly, this is a lot of work for such a small equation. But the good news is that if you need any equation on a regular basis, you can create it once while recording it as a macro and then run the macro whenever you need the equation again.—*M. David Stone*

SPREADSHEETS

Splitting Large Files— A Better Approach



I was disappointed with the advice given to Clyde Borrell in the June 13 Solutions column. Mr. Borrell wanted an easy way to split a 100,000-line ASCII file into 5,000-line subsets. I don't see how using a text editor and manually deleting lines 20 times is the "simplest solution." A better approach, in my opinion, is to write a short QuickBasic program that can split any file into subsets of any length. I suspect that many people don't even know QuickBasic comes with DOS, let alone appreciate its flexibility and power relative to its ease of use.

ANDREW J. EPSTEIN, Washington, D. C.

PC MAGAZINE: Mr. Epstein's point (and that of the various other readers who submitted similar comments) is well taken: For ad hoc file partitioning, a text editor is fine. For repetitive work, a program is much better.

We've modified Mr. Epstein's program a little so that it's shorter and displays its

progress. The result, SPLIT.BAS, appears in Figure 8. To use it, simply replace TESTER.DAT at the top of the program with the name of the large file that you want to break up. As it stands, SPLIT.BAS is set to generate 5,000-line output files. You can assign a different value to the MaxLine% variable if you prefer a finer or a coarser chop. The output files are named OUT1, OUT2, and so on.

Keep in mind that you should not use this program on spreadsheet files, only on text files you may later import into a spreadsheet.—*Craig Stinson and Jay Munro*

DATABASES

Checking the Existence of a Directory



In many of my database applications, I need to know for sure whether a directory exists. Is there a way to determine this from within my FoxPro for Windows programs?

SARA SCHAEFFER, Atlanta, Georgia

PC MAGAZINE: I've seen a number of different techniques for determining whether a directory exists. Some use FoxPro's ADIR() function to look for the directory, and others use the FILE() function to check whether a NUL file exists in the directory (according to DOS, the NUL device exists in every directory, but this is not reliable on some networks). Neither

'SPLIT.BAS: Based on file by Andrew J. Epstein, modified by Jay Munro

```
InFile$ = "TESTER.DAT"      'original huge file
MaxLine% = 5000             'maximum size of component files
FileCount% = 0              'filename counter

OPEN InFile$ FOR INPUT AS #1 'main file

DO WHILE NOT EOF(1)
    FileCount% = FileCount% + 1 'file counter
    OPEN "OUT" + LTRIM$(STR$(FileCount%)) FOR OUTPUT AS #2
    PRINT "Creating output file number "; FileCount%;

    'track maximum line and end of file
    i% = 0
    WHILE ((i% < MaxLine%) AND (NOT EOF(1)))
        i% = i% + 1
        LINE INPUT #1, InLine$
        PRINT #2, InLine$
    WEND
    CLOSE #2
    PRINT " - Lines = "; i%
LOOP
CLOSE #1
END
```



FIGURE 8: This QuickBasic program splits a file into subset files of any length you specify.

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```
*****
* FUNCTION Isdir(cDir)                                FoxPro for Windows 2.6
* Returns .T. if the passed parameter is a valid directory, where
* valid is defined as acceptable to the SET DEFAULT TO command.
*****
FUNCTION Isdir
PARAMETER cDir
PRIVATE lError, cOldErr, cOldDefa
cOldDefa = SYS(5)+SYS(2003)      && Save old set default
cOldErr = ON("ERROR")          && Save old on error
lError = .F.                    && Initialize to false
ON ERROR lError = .T.           && Set up error handler
*
* Attempt to set default to the directory. If the directory does
* not exist, or if the parameter passed causes an error, lError will
* be set to .T. by the ON ERROR handler. Otherwise, the directory
* must be valid.
*
SET DEFAULT TO (cDir)           && Attempt set default

ON ERROR &cOldErr                && Restore original error handler
SET DEFAULT TO (cOldDefa)        && Restore original set default
RETURN IIF(lError, .F., .T.)     && Return .T. if no error occurred
```



FIGURE 9: You can use this Isdir function in your FoxPro programs to determine whether or not a certain directory exists.

of these techniques is reliable all the time.

The best and most reliable technique is shown in the Isdir function in Figure 9. This function takes a very logical approach to checking for the existence of the directory: It sets up an error handler and then attempts to change to that directory using the SET DEFAULT TO command. If the attempt succeeds, the directory must exist, but if the error handler is triggered, the directory must not exist.

Here's how the Isdir function in Figure 9 works: First, we save the current directory and FoxPro's current error handler so that we can restore them later. Then we set up a variable, lError, to hold a value that indicates whether an error occurs when we try to switch directories. We initialize it to False. Next, we install a new error handler that will set the lError variable to .T. if an error occurs. Finally, we attempt to change to the directory in question using FoxPro's SET DEFAULT TO command. If the command works, the lError variable will remain false. If the command doesn't work, FoxPro will call our error handler and the lError variable will be set to true. This means the specified directory does not exist or something else is wrong with the string passed to the function.

Once we know whether or not an error occurred, we restore the original directory and error handler, and then return .T. if no errors occurred or .F. otherwise.

You can download the Isdir function from ZiffNet. Look for ISDIR.PRG in the Spreadsheet/DBMS library of the Utilities/Tips Forum. —Sal Ricciardi

GRAPHICS

Bloated PageMaker Files



I use the Windows 3.1 Clipboard to paste-link 12 to 18 Excel 5.0 charts into PageMaker 5 publications for my weekly reports. After I finish a report, the smallest file size is 3MB, and some files grow as large as 8MB. Strangely, even when I delete all the contents in a document, the size of the file remains roughly the same! This creates a real storage shortage, as I must keep a copy of the reports on disk. How does this happen? Could it be associated with the links that are maintained for the charts? More important, what can I do to correct the problem?

ROBERT HALILI, Hong Kong

PC MAGAZINE: As you suspect, when you use the Paste Link or Paste Special commands on PageMaker's Edit menu, you are employing Object Linking and Embedding (OLE). Paste Link creates a link to the original spreadsheet; Paste Special either creates a link or embeds the spreadsheet's data in your document. OLE has many advantages, not the least of which is the ability to edit the data from within the importing application by invoking the source program. If the file is linked (rather than embedded), any changes you make will automatically update the original.

Despite these positive points, however, OLE produces substantial overhead. I performed an informal test and created several

identical PageMaker documents. The publication that contained OLE links to Excel spreadsheets was over 30 percent larger than the publication created with PageMaker's standard import filters. And when an embedded OLE object was inserted into the document (with the Paste Special command), the file size was four times as large.

Instead of paste-linking or embedding spreadsheets, you should either use the straight Paste command or import what you need from the spreadsheets with the Place command (located on the File menu). I suggest you use the Place command, because PageMaker's Excel import filter gives you almost as much flexibility as linking via the Windows Clipboard. For example, the Clipboard allows you to import a smaller portion of a large spreadsheet by highlighting the relevant cells in Excel. But you can perform essentially the same operation by first creating a named range in the Excel worksheet and then specifying the named range within PageMaker's Excel import filter. Best of all, PageMaker maintains its own proprietary links to Placed files. And as with OLE, you can use PageMaker's links to update the data from externally stored spreadsheets automatically whenever the source file has been changed.

Your publication files are not getting smaller for a good reason. PageMaker speeds up the Save operation by merely appending the changes you make to the file structure. As a result, your publication can actually grow in size as you "delete" an object, because PageMaker is merely adding an instruction to remove that object. If you want to reduce the size of the file, use the Save As command instead of Save. The Save As command compresses the publication to its smallest size by storing only the most current data. Choosing Smaller from the Preferences dialog will make Save compress publications too. —Luisa Simone

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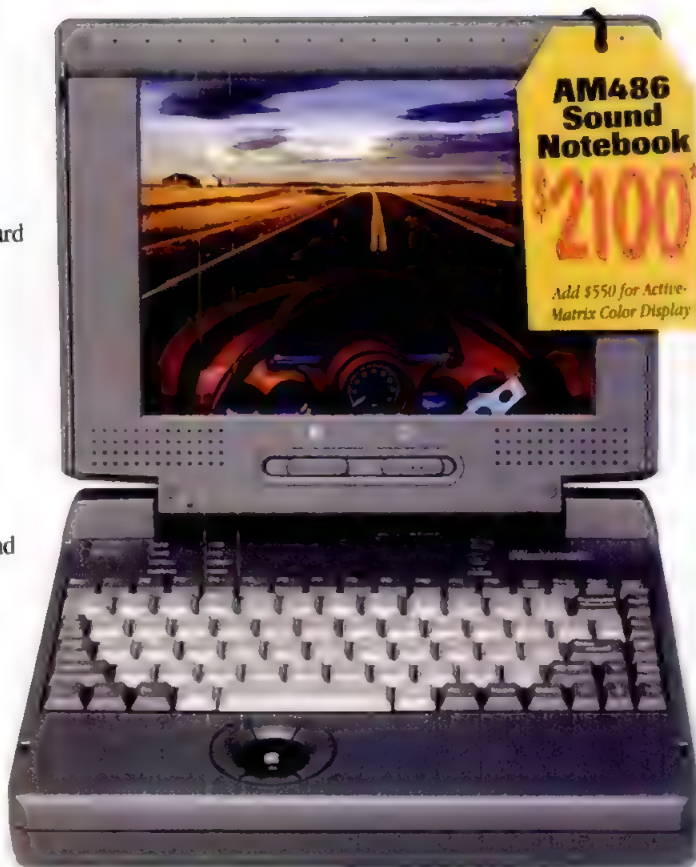
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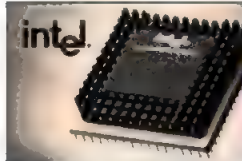
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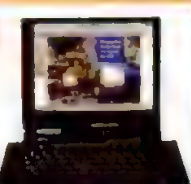


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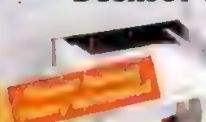
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HP OmniBook 5000

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- High resolution - 800x600 resolution on notebook display
- Built-in 16-bit sound, microphone & speaker

Model	Screen	RAM	Price
486DX2/50	8.5" Dual Scan	260MB	\$2549
486DX4/75	8.5" Dual Scan	260MB	3049
486DX4/75	9.5" Active	260MB	3649

Processor	Screen	RAM	Price
Pentium 90	10.4" Active	1.2GB	\$5579
Pentium 90	10.4" Active	1.2GB	6239*

*16MB RAM standard

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- Latest Intel processor technology

Model	Screen	RAM	Price
486DX4/100	10.4" Dual Scan	340MB	\$3499
486DX4/100	10.4" Dual Scan	540MB	3849
486DX4/100	10.4" Dual Scan	810MB	4299
486DX4/100	10.4" Active	340MB	4299
486DX4/100	10.4" Active	540MB	4649
486DX4/100	10.4" Active	810MB	5099
486DX4/100	10.4" Active	540MB	5649*
486DX4/100	10.4" Active	810MB	6099*
Pentium 75	10.4" Active	540MB	4749*
Pentium 75	10.4" Active	810MB	5199*
Pentium 75	10.4" Active	540MB	5799
Pentium 75	10.4" Active	810MB	6249

*Features built-in CD-ROM drive
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ThinkPad® 701

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Model	Screen	RAM	Price
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486DX2/50	10.4" Active	540MB	4049
486DX4/75	10.4" Dual Scan	360MB	3549
486DX4/75	10.4" Dual Scan	540MB	3849
486DX4/75	10.4" Active	360MB	4299
486DX4/75	10.4" Active	540MB	4599

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Model	Screen	RAM	Price
486DX4/100	10.4" Active LCD	540MB	\$6099
486DX4/100	10.4" Active LCD	810MB	7099*
486DX4/100	10.4" Active LCD	810MB	7549*

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- Integrated Accupoint - small, accurate & easy to use
- Lithium Ion battery technology
- Built-in infrared for no-hassle printer connections

Processor	Screen	MB	Price
Pentium 75MHz	10.4" Dual Scan	810MB	\$3539
Pentium 75MHz	10.4" Active	810MB	4359



Satellite Pro 400

Portégé 610CT

Processor	Screen	MB	Price
Pentium 90MHz	9.5" True Color	720MB	\$4359

90MHz
Pentium



610CT

Satellite T2110/T2130

- 10.4" Dual Scan & Active
- Built-in AC adapter - small, sleek design & reduced weight
- Integrated Accupoint - small, accurate & easy to use

Processor	Screen	MB	Price
486DX4/75	10.4" Dual Scan	330MB	\$1979
486DX4/75	10.4" Dual Scan	500MB	2459
486DX4/75	10.4" Active	500MB	3059

T2130



T2130

Additional Toshiba Notebooks

Processor	Screen	MB	Price
T4900CT			
Pentium 75	10.4" Active	772MB	\$4799
T4850CT			
486DX4/75	10.4" Active	772MB	\$3349
Satellite T2100			
486DX2/50	9.5" Mono	250MB	\$1239
486DX2/50	10.4" Dual Scan	330MB	1789
486DX2/50	8.4" Active	330MB	2399
Satellite T2150			
486DX4/75	10.4" Dual Scan	500MB	\$2929
486DX4/75	10.4" Active	500MB	3699

T4900

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Versa P

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- Replace floppy w/ Versa Bay - Add extra PCMCIA
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- Upgradable hard drive - easily add more storage

Versa 2000

- Lithium Ion battery technology
- VersaGlide touch-pad pointer - simple & accurate
- Built-in, upgradable 14.4 fax/modem (Active models only)
- LOADS of FREE software preinstalled

Processor	Screen	MB	Price
486DX4/75	10.4" Dual Scan	350MB	\$1999
486DX4/75	9.5" Active	350MB	2299*
486DX4/75	9.5" Active	350MB	2599
486DX4/75	9.5" Active	540MB	2799
*14.4 fax/modem not built-in			

Processor	Screen	MB	Price
Pentium 75	9.5" Active	340MB	\$3799
Pentium 75	9.5" Active	540MB	4349
Pentium 75	9.5" Active	810MB	4729
Pentium 75	9.5" High Res.	540MB	4539
Pentium 75	9.5" High Res.	810MB	4899
Pentium 75	10.4" Active	540MB	4629
Pentium 75	10.4" Active	810MB	4999
Pentium 75	10.4" High Res.	810MB	5199

Additional Products from NEC

Processor	Screen	MB	Price
Versa M			
486DX4/75	9.5" Dual Scan	250MB	\$2369
486DX4/75	9.5" Dual Scan	340MB	2459
486DX4/75	9.5" Active	340MB	2739
486DX4/75	9.5" Active	540MB	3029
486DX4/75	9.5" High Res.	540MB	3199
486DX4/100	9.5" Active	340MB	3399
486DX4/100	9.5" Active	810MB	4069
486DX4/100	9.5" High Res.	540MB	3879
486DX4/100	9.5" High Res.	810MB	4249
Ready Multimedia			
Minitower	486DX4/100	540MB	\$1699
Minitower	Pentium 75	850MB	1999
Minitower	Pentium 90	850MB	2199
Minitower	Pentium 90	1.2GB	2599
Minitower	Pentium 100	1.2GB	2799

Ready Multimedia

Versa V

- Replace floppy w/ 2nd battery for 6-10 hrs battery life
- Upgradable hard drive - easily add more storage
- 32 bit local bus with 1MB video RAM
- 64K colors on notebook display (Active only)

Processor	Screen	MB	Price
486DX2/50	9.5" Dual Scan	250MB	\$2129
486DX2/50	9.5" Dual Scan	340MB	2179
486DX2/50	9.5" Active	250MB	2269
486DX2/50	9.5" Active	340MB	2369
486DX2/50	9.5" Active	540MB	2649
486DX4/75	9.5" Active	340MB	2549
486DX4/75	9.5" Active	540MB	2739
486DX2/50	10.1" Active	340MB	2549
486DX4/75	10.1" Active	540MB	2929

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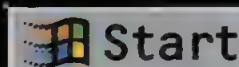
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Processor	Screen	HD	Price
486DX4/75	10.4" Dual Scan	420MB	\$2459
486DX4/75	10.4" Active	420MB	3029
486DX4/100	10.4" Dual Scan	720MB	2839
486DX4/100	10.4" Active	720MB	3499

ProLinea

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- Compaq, 3-year worldwide warranty with 1st year on-site

Chassis	Processor	HD	Price
Desktop	486DX2/50	270MB	\$1129
Desktop	486DX2/66	420MB	1529
Desktop	486DX4/100	420MB	1719
Minitor	Pentium 75	720MB	2399

Monitors priced separately

ProLinea

LTE Elite

- 10.4" Active Matrix display
- Fast 486DX4/75 processor
- Built-in AC adapter - small, sleek design & reduced weight
- Upgradable hard drive - easily add more storage

Processor	Screen	HD	Price
486DX4/75	9.5" Dual Scan	340MB	\$2739
486DX4/75	9.5" Dual Scan	510MB	3119
486DX4/75	10.4" Active	510MB	4159
486DX4/75	10.4" Active	810MB	4539

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- 3-year warranty - **FREE** 1-year Passport Service

Processor	Screen	HD	Price
486DX2/50	9.5" Active	240MB	\$2879
486DX4/75	9.5" Dual Scan	510MB	2869
486DX4/75	9.5" Active	340MB	3249
486DX4/75	9.5" Active	510MB	3589

Processor	Screen	HD	Price
486DX2/50	9.5" Dual Scan	340MB	\$2959
486DX2/50	9.5" Active	340MB	4119
486DX4/75	9.5" Active	340MB	4579
486DX4/75	9.5" Dual Scan	528MB	3659
486DX4/75	9.5" Active	528MB	4719

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- PCI local bus, high-speed graphics
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Chassis	Processor	HD	Price
Minitor	Pentium 75	1GB	\$1699
Minitor	Pentium 75	1.2GB	2019
Desktop	Pentium 100	850MB	1869
Minitor	Pentium 100	1.6GB	2449*
Minitor	Pentium 133	1.2GB	2359

*includes FastMedia Remote Control
Monitors priced separately

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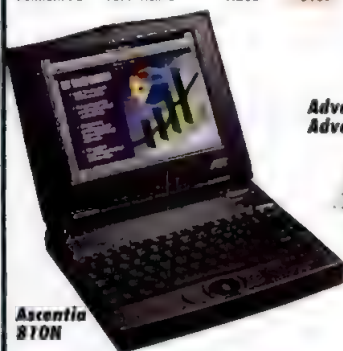
- 10.4" Active & 10.3" Dual Scan
- Lithium Ion battery technology
- Intelligent power management to maximize performance
- Integrated Smartpoint - small, accurate & easy to use

Processor	Screen	MB	Price
486DX4/75	10.3" Dual Scan	510MB	\$2649
486DX4/75	10.3" Dual Scan	700MB	2929
486DX4/75	10.4" Active	510MB	3689
486DX4/75	10.4" Active	700MB	3969

Ascentia 950N

- 75MHz Pentium for blazing performance
- 10.4" Active & Dual Scan
- High Res. displays - 800x600 res. on notebook
- Built-in 16-bit sound, microphone & speaker
- Lithium Ion battery technology
- Built-in infrared for no-hassle printer connections

Processor	Screen	MB	Price
Pentium 75	10.4" Dual Scan	500MB	\$3299
Pentium 75	10.4" Dual Scan	800MB	3589
Pentium 75	10.4" Dual Scan	1.2GB	4059
Pentium 75	10.4" Active	800MB	4719
Pentium 75	10.4" Active	1.2GB	5189



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Ascentia 810N

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Desktop	486DX2/66	540MB	1299
Desktop	Pentium 75	540MB	1589
Minitorwer	Pentium 75	1GB	1999
Minitorwer	Pentium 90	1GB	2149
Minitorwer	Pentium 100	1GB	2799
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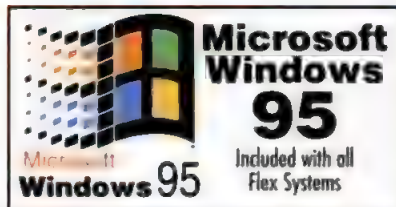
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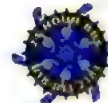
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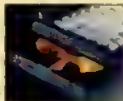
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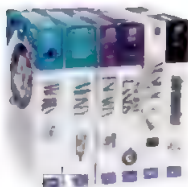
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ThinkPad 756C 486DX/100MHz	340MB, 8MB, 10.4" Active Matrix Color	\$4,299
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ThinkPad 755CSE 486DX/100MHz	540MB, 8MB, 10.4" Active Matrix Color	\$5,849
810MB, 8MB, 10.4" Active Matrix Color		6,099
ThinkPad 755CV 486DX/100MHz	540MB, 8MB, 10.4" Active Matrix Color	\$6,099
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IBM PC Models

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486DX2/66	8/364MB	5x5	IBA6581L4F	1,553
486DX2/66	8/540MB	5x5	IBA6581L5F	1,545

IBM Pentium® Models

Processor	RAM/HD	Storage/Bus	Prod. Code	Price
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Pentium® 75MHz	16/540MB	3x3	IBA657635H	2,199
Pentium® 75MHz	16/850MB	3x3	IBA658635F	2,283
Pentium® 75MHz	16/540MB	5x5	IBA658635H	1,860
Pentium® 75MHz	16/540MB	5x5	IBA658635H	2,225
Pentium® 75MHz	16/850MB	5x5	IBA658637H	2,340
Pentium® 90MHz	8/540MB	3x3	IBA657645F	2,225
Pentium® 90MHz	16/540MB	3x3	IBA657645H	2,570
Pentium® 90MHz	16/850MB	3x3	IBA657647H	2,885
Pentium® 90MHz	16/540MB	5x5	IBA658645F	2,283
Pentium® 90MHz	16/540MB	5x5	IBA658645H	2,629
Pentium® 90MHz	16/850MB	5x5	IBA658647H	2,743

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- 10.4" Active Matrix Color Display
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AST Ascentia 910N 486DX/75MHz	510MB, 8MB, 10.3" Dual Scan Color	\$2,589
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AST Ascentia 950N Pentium® 75MHz	500MB, 8MB, 10.4" Dual Scan Color	\$3,269
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260MB, 4MB, 8.5" Dual Scan Color		2,505
OmniBook 600C 486DX/75MHz	170MB, 8MB, 8.5" Dual Scan Color	\$2,819
260MB, 8MB, 8.5" Dual Scan Color		2,969

EMULE

SENS800 Pentium® 75MHz	520MB, 8MB, 10.4" Dual Scan Color	\$2,799
810MB, 8MB, 10.4" Active Matrix Color		3,299
SENS800 Pentium® 90MHz	1.3GB, 8MB, 10.4" Active Matrix Color	\$3,799

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XJack 14.4/14.4 PC Card Fax/Modem	\$179
XJack Cellular 14.4/14.4 Fax/Modem	199
Gold Series 14.4/14.4 PC Card Fax/Modem	209
Combo 14.4/Ethernet PC Card	379
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50703-301

AST Bravo Models

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486DX4/100	8/540MB	501443-401	1,494*
75MHz Pentium®	8/540MB	501701-401	1,664*
75MHz Pentium®	16/1GB	501701-501	2,264*
90MHz Pentium®	8/540MB	501534-401	1,934*
90MHz Pentium®	16/1GB	501534-501	2,534*
100MHz Pentium®	8/540MB	501754-301	2,104*
100MHz Pentium®	16/1GB	501754-401	2,704*

*Models listed are desktop. Low-profile and mid-tower cases also available. After 575 manufacturer's retail-in release—offer ends 9/30/98.

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330MB, 8MB, 8.4" Active Matrix Color		2,699
330MB, 4MB, 10.4" Dual Scan Color		\$2,199
T2130C95 486DX4/75MHz	500MB, 8MB, 10.4" Dual Scan Color	\$2,559
500MB, 8MB, 10.4" Active Matrix Color		3,079
T2150C Series 486DX4/75MHz	500MB, 4MB, 10.4" Dual Scan Color	\$3,099
500MB, 8MB, 10.4" Active Matrix Color		3,719
T2450CT 486DX4/75MHz	320MB, 8MB, 9.5" Active Matrix Color	\$3,155
500MB, 8MB, 9.5" Active Matrix Color		3,239
Portégé 610CT Pentium® 90MHz	680MB, 8MB, 9.5" Active Matrix Color	\$4,399
Satellite Pro 400 Pentium® 75MHz	720MB, 8MB, 10.4" Dual Scan Color	\$3,999
720MB, 8MB, 10.4" Active Matrix Color		4,819
T2500CT 486DX4/75MHz	500MB, 8MB, 10.4" Active Matrix Color	\$3,325
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17" 17GS, 27, 1280x1024, N.I. CMV90N17GS	749
17" 17PS, 25, 1600x1200, N.I. CMV90N17PS	1,059
20" 20PS, 28, 1600x1200, N.I. CMV90N20PS	1,569
21" 21PS, 25, 1600x1200, N.I. CMV90N21PS	1,899

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Sportster 28.8/14.4 External MBUSR324E	239
Sportster V1 14.4/14.4 Internal MBUSRV14I	100
Sportster V1 14.4/14.4 External MBUSRV14E	129
Sportster V1 28.8/14.4 Internal MBUSRV28I	249

BocaModem 14.4/14.4 Internal MB8R144I	\$79
Boca Sound Expression 14.4/14.4 Int. MB8RV144I	169
BocaModem 28.8/14.4 Internal MB8R284I	169
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17" MXP17F, 28, 1280x1024, N.I. CMXMP17F	899
21" MXP21F, 28, 1600x1200, N.I. CMXMP21F	1,829

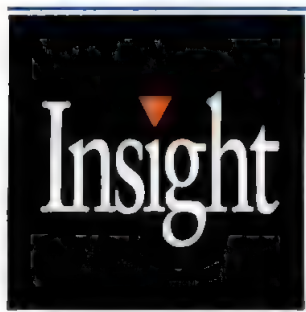
CTX

14", 28, 1024x768, N.I. CMCT1451C	\$239
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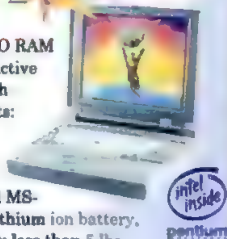
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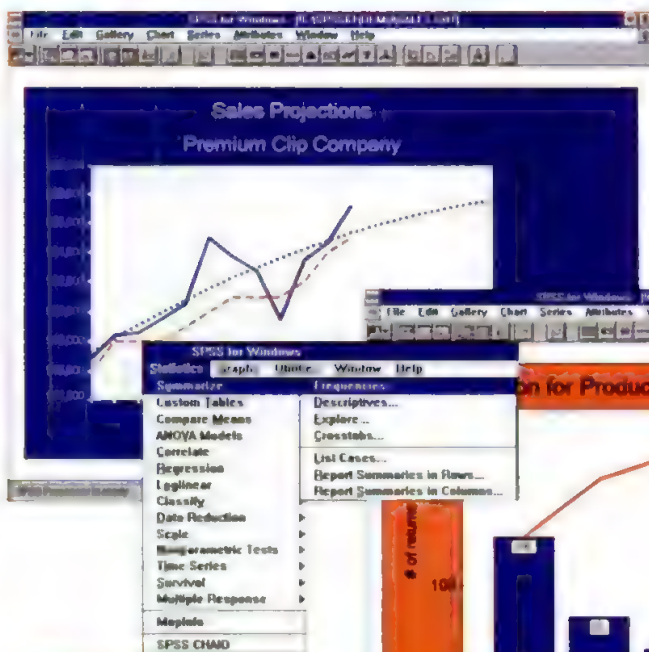
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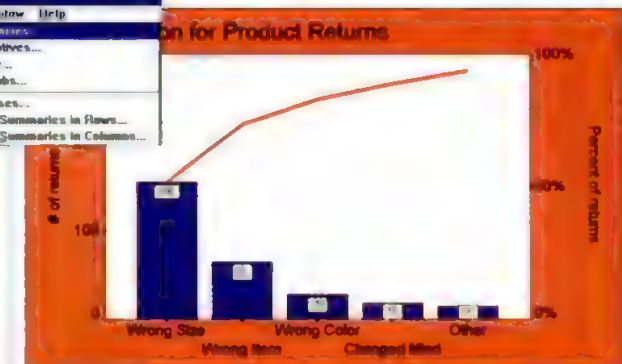


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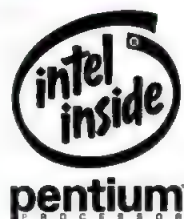
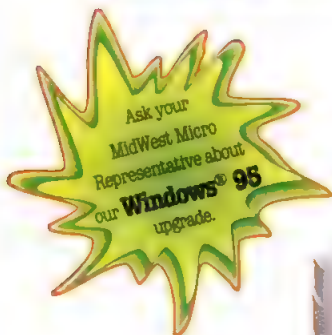


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Source: PC Magazine "Tapping the Promise of the Pentium" - May 30, 1995

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14.4 Kbps w/VoiceView, internal	005211	\$29
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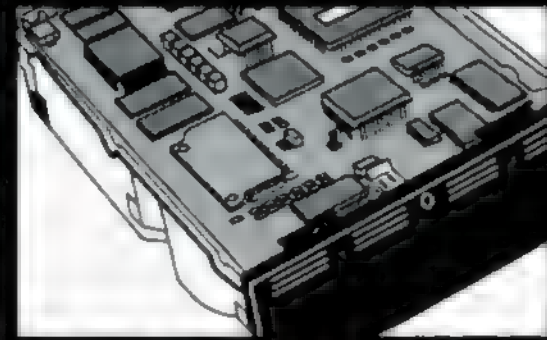
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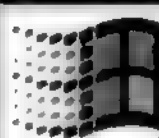
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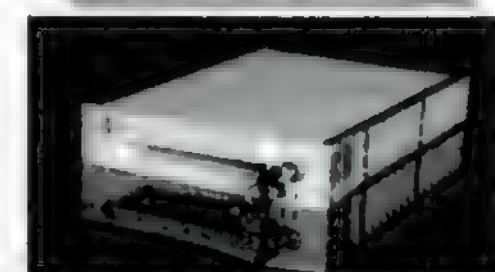
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Windows.....		359
Adult.....		362

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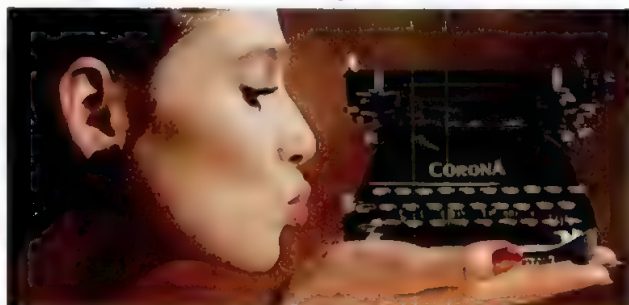
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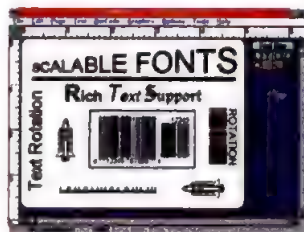


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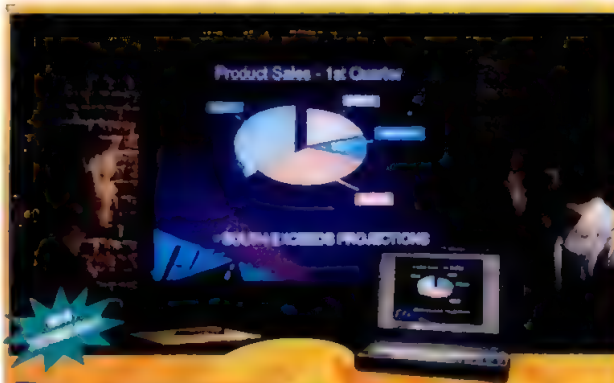
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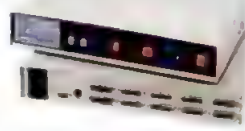
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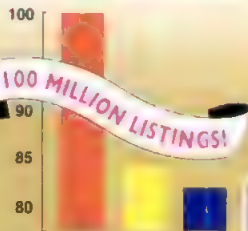
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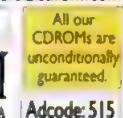
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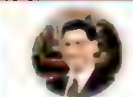
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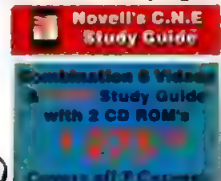
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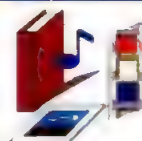


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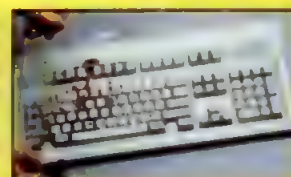
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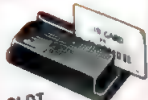
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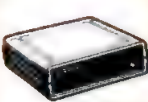
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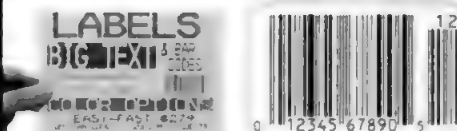
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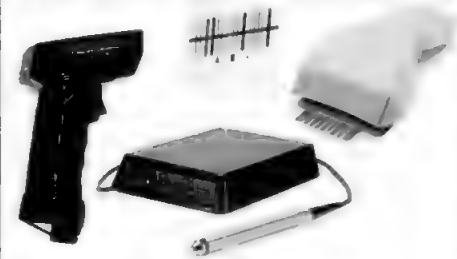


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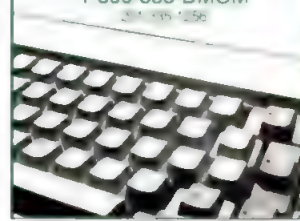
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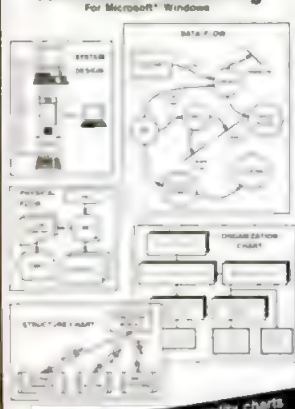


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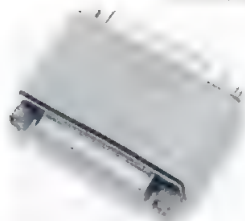
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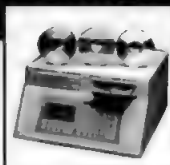
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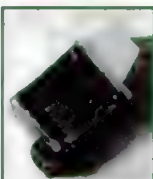
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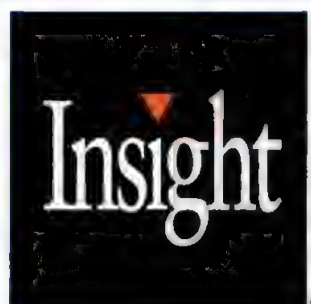
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Marble notebooks and No. 2 pencils line the store shelves; the smell of peanut butter and jelly hangs heavy in the air, and magnet-hung schedules are taking over the 'fridge door. It's back-to-school time again, and with 30 million families owning PCs, we've turned a critical corner. More than ever before, PCs and software will be a natural part of the school experience.

Researchers are having a field day figuring out whether any of this software really helps Johnny read, write, or do his math better, but even without definitive studies, it's clear that computers have captured the imagination of our children.

PC Magazine At Home's special Back-to-School coverage takes you through your children's formative years, high-tech style.

We divided the student body into four groups: **Preschool, Kindergarten-Grade 6, Grades 6-12, and College and Beyond.** For each age group, we looked at a multitude of titles and then chose the best by factoring in ease

of use, content, how engaging the title was, and how educationally valid the program seemed. While some software spans multiple age ranges (see the chart "Back-to-School Software"), most packages tie into a particular period of a student's career. Within each age range you'll find products for reading, writing, creative projects, science, and more. We list average prices for these pro-

grams, but you may be able to find them for less.

Besides reading the product sections, be sure to check our sidebars about on-line homework helpers and CD-ROM reference material. And, since students don't live by software alone, check our guide on choosing the best PC to take back to school.

If you'd like to find out more about these products, don't miss our on-line event, At Home Plus. From September 11-15, you can go on-line to talk with the developers of some of these titles. Type GO EXEC from any CompuServe! prompt.

—Robin Raskin



IN THIS ISSUE

Preschool.....	370	Way to an A.....	379
Kindergarten-Grade 6.....	374	Choosing the Best PC to Take Back to School.....	384
Grades 6-12.....	379	Back-to-School Software Chart ..	388
College and Beyond.....	389	Five Utilities Every Parent Should Have	390
Dialing for Homework.....	376		
Cut and Paste Your			

Preschool

The best software for the finger-painting set understands that little kids won't learn anything unless you make the learning fun. These ten products provide just the right mix of education and entertainment.

Alphabonk Farm (\$35 estimated street price; Headbone Interactive, 800-267-4709) is just about the most off-beat and flat-out fun product around. Here, friendly farmer Alphred A. Bonk and his barnyard buddies teach kids 4 to 8 the alphabet through witty animations, funky photos, ridiculous rhymes, and unusual activities such as Poke 'N' Prod and Seek 'N' Find. The littlest computer



Catchy tunes help prereaders learn the alphabet in Fisher Price ABC's.

users may find the object search game Seek 'N' Find a bit too tough to manage on their own, but they'll love Poke 'N' Prod, where the object is to coax Bunji the Frog into spitting out animated objects, then feeding them back to him. All ages will enjoy the high-quality photos, silly songs, and the more than 30 hours of playtime.

Fisher Price ABC's (\$39.75; Davidson & Associates, 800-545-7677) takes a more traditional approach by using musical rhymes to teach kids aged 3 to 5 the alphabet,

beginning phonics, and reading readiness. The star of the production is the Jungle Jukebox. Kids must click around till they find coins, then feed them to the jukebox to play one of three games: Letter Hip Hop (a letter-recognition game); Jingle Bebo (a letter-reinforcement game); and Word Do-Wop (a word-building game). There are two modes of play: Kids at the lower end of the age range can explore, while those ready for a bit more of a challenge can opt for a goal-oriented approach. The best part, though, is that the software's bold, witty animations give it the look and feel of a traditional Fisher Price toy.

For preschoolers ready to move beyond ABCs to actual reading, there is **Reader Rabbit's Interactive Reading Journey** (\$99 estimated street price; The Learning Company, 800-852-2255). This animated adventure uses 40 stories that increase in difficulty to help kids 3 to 6 learn to read. Children can read the storybooks themselves or listen as Reader Rabbit

and Sam the Lion read aloud to them. But there's more to the program than interactive storybooks. To help reinforce the words they've encountered in the stories, kids can visit the skill houses. There they'll find a score of activities that teach phonics, word recognition, and how to sound out words.

Me and My World Multimedia Dictionary (\$49.95; Future Vision Multimedia, 516-482-0088) provides even more word fun. This picture dictio-



nary helps kids 3 to 6 build up their vocabulary and word-recognition skills. An animated guide named Timmy helps explain what kids should do in each of 18 scenes, which include such familiar locales as the Classroom, the Post Office, and the Doctor's Office. In each of these scenes, kids simply click on an object to hear its name pronounced and to see it spelled out. After exploring a few scenes, kids can retire to the Projection Room, where

the object is to associate a picture of an object they've seen with its name.

Kids anxious to try out their reading skills will enjoy **The Berenstain Bears Get in a Fight** (\$40 estimated street price; Living Books, 800-776-4724). This interactive storybook follows the usual Living Books pattern: tons of witty hot-spot animations, a story kids can read or have read to them in English or Spanish, and a story line that teaches a subtle lesson. Here the lesson for kids 3 to 8 is how to resolve



differences that occur in everyday life. What's new is the appearance of the ever-popular *Berenstain Bears* in two extended animation sequences, a video interview with authors Jan and Stan Berenstain, and a *Parents' and Kids' Activity Book*.

Another set of popular kids' characters make their CD-ROM debut on **Sesame Street: Numbers** (\$40 estimated street price; Creative Wonders, 800-245-4525). Kids 3 to 6 follow Elmo to four locations where they can play

counting, classification, and number-recognition games with Big Bird and the gang. There's also a storybook to read, as well as a television and radio that play Sesame Street videos and songs. No matter what they're doing in the program, kids will be encouraged and guided by the Sesame Street characters. Parents should be aware, though, that this is a DOS game, and that it requires a Creative Labs SoundBlaster-compatible-

sound card.

More familiar characters and more exploration are on tap in **How Things Work in Busytown** (\$49.95; Viacom New Media, 800-469-2539). Adapted from the books of Richard Scarry, this beautifully animated program teaches kids 3 to 6 how a community functions. By visiting various locales, young explorers discover that to bake bread, the baker needs wheat from the mill; at the mill, they find out that the wheat

Pictured on the monitors in this high-tech classroom, from left to right, are *AlphaBunk Farm*, *Magic School Bus Explores the Human Body*, and *License to Drive*.

must come from the farm. At the farm, kids must help plant, plow, and harvest. There are lots of fun places to explore, and the activities are simple enough for the littlest of computer users.

Kids learn more about exploring and problem-solving in **Freddi Fish and the Case of the Missing Kelp Seeds** (\$40

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K N A P S A C K

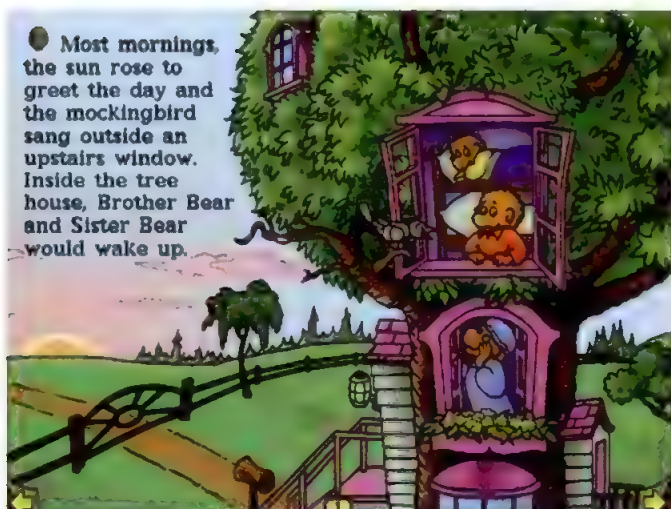


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Read, play, and explore in *The Berenstain Bears Get in a Fight*.

estimated street price; Humongous Entertainment, 206-485-1212). In this vividly animated graphic adventure, kids 3 to 8 help Freddi and her young friend Luther find out what happened to Grandma Grouper's kelp seeds.

To unravel the mystery, kids will need to engage in some simple problem-solving and critical thinking. They'll also have the opportunity to learn math from a sympathetic starfish. They'll be richly rewarded for their efforts with more than 40 locations to explore, and hundreds of entertaining sounds and hot-spot animations to enjoy.

JumpStart Kindergarten (\$54.95; Knowledge Adventure, 800-542-4240) combines multiple learning activities with hot-spot animations. This multimedia virtual kindergarten provides kids 4 to 6 with language, math, reading, and critical-thinking activities, all in a familiar environment. Kids can play counting, pattern-matching, and letter

games—as well as paint pictures. All of these games adapt to the child's ability, increasing in difficulty with each right answer.

JumpStart Kindergarten can track the progress of multiple children and produce a separate report card for each one or a group report card so that parents or home educators can see where the kids need help. When the kids are ready to advance, take a look at sister product **JumpStart First Grade**.

Kids definitely won't need help figuring out what to do with **Crayola Amazing Art Adventure** (\$40 estimated street price; Micrografx Inc., 800-676-3110). Creativity is an important skill for preschoolers to master, and this program lets kids 3 to 6 paint, draw, and scribble to their hearts' content.

Crayola Amazing Art Adventure contains fun activities, witty animations, and simple games presented in a colorful point-and-click envi-

ronment. The electronic markers, crayons, and paintbrushes are little-kid-sized, and each tool makes a distinctive sound when used. The animated stickers are especially amusing.

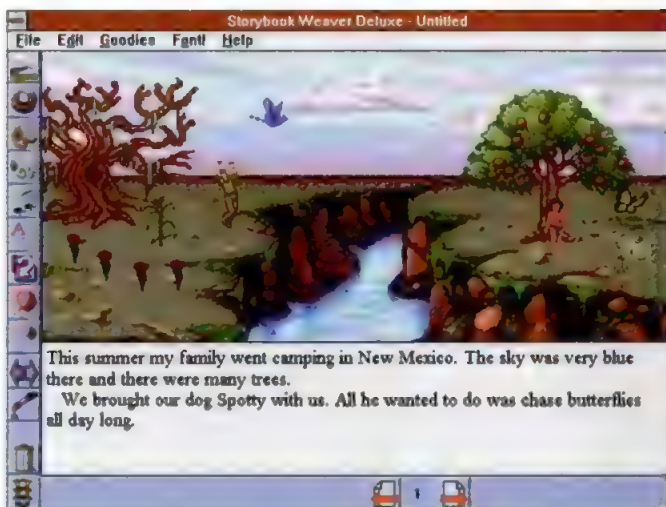
Older kids might enjoy a sister product, **Crayola Art Studio**, which adds a variety of creativity projects and more sophisticated drawing tools to the already full paintbox.—Gayle C. Ehrenman

Kindergarten-Grade 6

The years between kindergarten and sixth grade are perhaps the most critical in a student's career. It's during this period that students must acquire skills that will help them succeed further down the educational line.

mated street price; Living Books, 800-776-4724) can go a long way to make sure kids aged 6 to 10 develop an interest in reading. Like its sibling, *The Berenstain Bears Get in a Fight*, this **Living Book** brings the written word to life with lots of silly hot-spot animations and vividly drawn pages. But the star here is the beautifully told story, adapted from a print book by children's author Marc Brown, which focuses on getting along with others and finding creative solutions to everyday problems. Kids can read by themselves or have the entire story or individual words read to them. And, of course, they can spend lots of time clicking around the story.

Kids who have a hard time following along with an animated storybook may want to spend some time with **Reader**



Create your own adventures with **Storybook Weaver Deluxe**.

The 15 products highlighted here cover all the basic skills for this age group, taking into consideration that what's perfect for a kindergarten student will bore a sixth grader to tears.

Reading is perhaps the most important skill for this age group to master, and **Arthur's Birthday** (\$40 esti-

mated street price; The Learning Company, 800-852-2255). This learning adventure casts kids 6 to 8 as junior reporters at the Wordville newspaper. While they're honing their reading comprehension, writing, and vocabulary skills, kids will be helping **Reader Rabbit** and the gang turn out a news-

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Here's Something You Don't See Everyday

In today's graphics-intensive computing environment, a high-resolution monitor quickly becomes a practical business necessity. Fortunately, the new DeluxScan™ 15 Pro and 17 Pro monitors can make the upgrade easy and cost-effective, with everything you need for crisp, clear, flicker-free images at resolutions up to 1600 x 1280 pixels.

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* EPA Energy Star, MPR II and DPMS.

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paper complete with stories they've authored. Parents can help the learning process along by setting reading and vocabulary levels to match those of the budding news-hound.

Once they've developed an interest in creative writing, introduce your kids to **Storybook Weaver Deluxe** (\$45 estimated street price; MECC, 800-685-6322, ext. 529). This bilingual English/Spanish writing assistant for kids 6 to 14

combines two previously released MECC products, *Storybook Weaver* and *My Own Stories*, with a host of new features. The focus here is on encouraging kids to write their own mystery, science fiction, or adventure stories. Kids can choose from thousands of graphic scenes, add the provided graphics or create their own, liven up the production with theme music and sound effects, and then have the whole thing read back to them

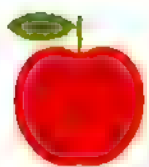
by the computer.

Creating interactive stories is also the focus of **Imagination Express Destination: Rainforest** (\$40 estimated street price; Edmark Corp., 206-556-8484). This creativity tool sets kids 6 to 12 down in a Panamanian rain forest, where they can select scenes, choose and animate characters, write stories, then add narration, music, and sound effects for the full multimedia

effect. There's also a fact book full of rain-forest information. Other Destination packs are available for creating stories in other settings, including a castle and a neighborhood.

My Make Believe Castle (\$40 estimated street price; Logo Computer Systems Inc., 800-321-5646) differs from other storytelling tools in that it focuses on the play side of storytelling rather than on the

Dialing for Homework



As on-line services continue to mature, a computer, a modem, and a phone line can go a long way toward providing help for homework. Can they replace libraries, teachers, hard-copy reference materials, or even, heaven forbid, mom and dad? Well, not quite yet, but with connection charges typically running about \$15 per month, they are starting to look like affordable adjuncts to more traditional help routes. Here's a sampling of on-line homework helpers.

Prodigy is about to introduce Classroom Prodigy, a service geared to teachers and students. Internet mail, newsgroups, chats, and auditoriums will be available for classroom use; the service also will include electronic field trips. In addition, Prodigy has been a longtime sponsor of NOVA materials, which regularly feature science and history discussions.

One of the gems on Prodigy is a service called Homework Helper, provided by Infonautics Corp. The service contains the text of hundreds of newspapers, magazines, and books, as well as photos, an encyclopedia, a dictionary, and transcripts of television and radio programs. Kids can enter a search query in natural English-language syntax.

America Online, still the handsomest of the services, draws kids like a magnet. Some of the more educa-

tional AOL offerings include *Kids-World*, which usually contains a school project, a kids' version of *Time*, a kids' newspaper called *Tomorrow's Morning*, the Library of Congress Online, National Public Radio, *US News & World Report*, CNN (with a special kids' section), and the *Smithsonian*.

Most exciting are AOL's interactive education services. In this area there are scheduled tutoring sessions, a "teacher pager" to summon an on-line teacher, message boards where students share ideas, an exam prep center, and a study skills center.

CompuServe has traditionally housed more information-sharing forums and interest groups for like-minded people than the other services. CompuServe's educational offerings for older students are strong, but it offers less for junior high school students than do the other on-line providers.

Databases such as Computer Library, Health Database Plus, Business Database Plus, and *Books in Print* are excellent references for more advanced students. Iquest provides access to more than 450 databases spanning the worlds of business, government, research, and news; it even includes popular entertainment and sports. If you can't find what you're looking you can request help from a specialist.

CompuServe offers some of the

best information available for the college-bound. Many colleges have on-line forums where admissions counselors answer questions. Reference materials include the *Academic American Encyclopedia* and *Peterson's College Guide*.

Internet searches can be overwhelming and time-consuming for kids and inexperienced searchers. There's always a strong chance of "misinformation"; that's because so much of what's available on the Internet comes from publishers promoting their personal agendas in addition to posting educational content.

On the World-Wide Web, one of the most popular educational sites is Ask ERIC (<http://ericir.syr.edu/>), a federally funded clearinghouse on the Internet for teachers and educators. Other interesting sites include Academy One[R] (www.nptn.org/cyber.serv/AOnePlace), an international on-line educational resource for students, educators, parents, and administrators of grades kindergarten-12. It has a collection of curricula, contests, forums, and references. CollegeNET (www.unival.con/cn/collegenet.htm) lets you browse institutions by various criteria that include geography, tuition, and enrollment. Kids Web (www.npac.syr.edu/textbook/kidsweb) is an electronic collection of places for students to go on the WWW, sorted by topic.—Robin Raskin

IT'S NOT IF. IT'S WHEN...

Introducing the new shape of advanced surge protection: SurgeArrest® by APC

The simple truth may be disturbing: most PC's already have more surge protection built into them than that provided by most so-called "surge protectors." In other words, buying no protection at all is as good as under spending on one of the most important PC decisions you can make. Worse yet, the only way you'll find out your "protection" is (or was) inadequate is the hard way: the school of high shocks.

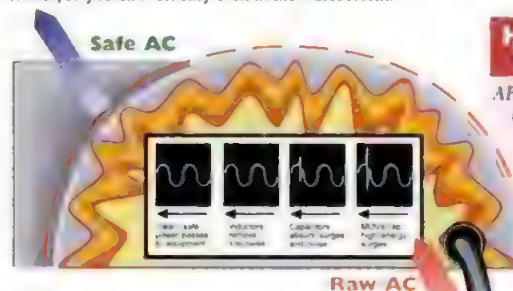
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While some things can be trusted to faith alone, proper power protection isn't one of them. Not surprisingly APC's SurgeArrest has become one of the fastest-growing lines of power protection in the world by doing what it says: stopping surges from damaging your sensitive electronics, today, tomorrow. Forever. With a lifetime warranty, SurgeArrest will be the last surge protector you ever have to buy.

APC's SurgeArrest provides the best performance because it packs the most protection inside its shell (guaranteed up to \$25,000*). Since SurgeArrest carries a lifetime warranty, it will be the last surge suppressor you'll ever have to buy.

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SurgeArrest is so advanced, its SafeShield design holds its own patent (#342,055). The smooth curves isolates your equipment from power problems, then pick them off one by one (see below). This multistage protection is far superior than single technology "surge suppressors." Moreover, a SurgeArrest is available for any application, including phone lines and cable TV, and performance is even backed by up to a \$25,000 repair/replacement guarantee on any properly protected equipment. Unlike competitive policies packed with fine print which disclaims their warranty for lightning strikes (just when you need it most!), SurgeArrest even provides protection against direct lightning strikes, so you can rest easy even in the worst storm.



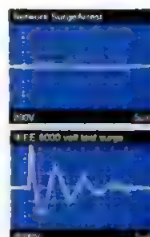
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APC's unique SafeShield design is so advanced, it's been granted U.S. Patent # 342,055. In addition to a multi-stage protection package, SafeShield provides a fail-safe fuse which guards against dangerous wiring faults, and catastrophic event protection to stop lightning strikes before they reach your equipment.



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Lab tests prove SurgeArrest's superiority, which eliminates a 6000 Volt surge (top) while Brand T lets through high levels to equipment (bottom).



But SurgeArrest goes beyond the performance you want to the safety you need. SurgeArrest's SafeShield design incorporates a fail-safe thermal fuse to reduce the danger of surge-induced fires, a site-wiring fault indicator to automatically diagnose dangerous wiring conditions, and Catastrophic Event Protection, to ensure that your delicate equipment is protected at all costs, even by sacrificing the unit. And since a "Protection Working" indicator is standard, you never have to wonder if SurgeArrest is prepared to take a hit. If the indicator goes out, simply call APC for a new SurgeArrest at no cost to you.

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Back to School: Grades K-6

writing side. This creativity program for kids 4 to 7 lets them play make-believe games in a variety of castle settings. Even prereaders will quickly master the point-and-click interface, which lets them choose scenes and characters to play with. Each of the 19 characters has an associated action that the child can control by setting the characters' paths and moods. In addition to animated play, each room of the castle includes a skill-building game.

A math castle designed for early readers is the setting of **Scooter's Magic Castle** (\$40 estimated street price; Creative Wonders, 800-245-4525). Here, kids 4 to 7 join Scooter on a learning adventure filled with more than 20 skill-based games. While they're trying to grow a magic garden or catch fish in the castle moat, kids will also be learning counting, pattern recognition, vocabulary, and problem-solving. There are three levels of difficulty, so play should always be challenging.

Poly Gonzales guides kids 6 to 10 through a variety of math games that help teach computation, estimation, fractions, patterns, math operations, and problem-solving in **Math Workshop** (\$40 estimated street price; Broderbund Software, 800-521-6263). The activities are engaging and unusual, ranging from the Rhythm Shop, where kids combine fractions to make a tune, to Bowling for Numbers, where kids solve math problems to defeat Gus the Gorilla at his own game. Parents will appreciate the included Parents' Video Guide and helpful tips scattered throughout the manual.

Teaching kids 8 to 12 to use math in real-life settings is the

goal of **Counting On Frank** (\$40 estimated street price; Creative Wonders, 800-245-4525). In this beautifully animated math adventure, kids are cast as Henry, a boy who sees the numerical side of everything, thanks to his ever-cool canine sidekick Frank. The goal here is to win the local jelly bean-counting contest by solving challenging math problems. There are eight environments to explore and four math activities that teach word problems, estimation, operations, measurements, and more. Kids will love the hot-spot animations



SimTown lets kids get in on city-building fun.

(don't miss Frank chewing bubble gum); parents will appreciate the mathematical depth of the program.

Kids get to dive deep within themselves in the comic adventure, **Magic School Bus Explores the Human Body** (\$50 estimated street price; Microsoft Corp., 800-426-9400). Kids 6 to 10 tour 12 different body parts along with the irrepressible Ms. Frizzle and her **Magic School Bus**, which are based on the Scholastic book series and PBS television series of the same name. There

are lots of interactive activities, experiments, and multimedia reports for kids to explore as they learn about body processes such as digestion and how the nervous system works. Of course, there are fun science games and engaging hot-spot animations. Kids who enjoy this one should also enjoy **Magic School Bus Explores the Solar System**.

Science Sleuths, Volume 1 (\$50 estimated street price; Video Discovery Inc., 800-548-3472) sets kids 12 to 15

tion (\$40 estimated street price; Broderbund Software, 800-521-6263). In this junior version of the popular **Carmen Sandiego** series, the goal for kids is to stop Carmen and her cohorts from making trouble around the world.

It's up to junior detectives ages 3 to 9 to uncover the clues that will help them catch the crooks. Along the way, kids will learn facts about a variety of countries and see digitized photos from many nations. The biggest differences between this version and the original Carmen games are that this version's interface and mode of play have been simplified to make it more fun for early readers.

Getting the right information for a report will be easier thanks to **Heinemann Children's Multimedia Encyclopedia** (\$60 estimated street price; Reed Interactive, 301-601-2245). This beautifully designed point-and-click reference work contains the complete text of the 11-volume print *Heinemann Encyclopedia*, as well as hundreds of multimedia enhancements. Kids 6 to 12 will find the easy-to-read articles arranged in useful categories, such as Earth and Beyond, and Famous Men and Women. For those already familiar with research methods, there's also a complete index and simple search tools.

The ability to solve problems creatively will come in handy in **Lenny's Multimedia Circus** (\$40 estimated street price; Viacom New Media, 800-469-2539). In this wildly illustrated adventure, kids 6 to 10 explore Lenny the Penguin's crazy circus, where

down in a virtual science lab. Their goal is to solve two different mysteries by digging through video interviews; examining maps, graphs, and documents; conducting experiments to prove their theories; and recording their findings and solutions in an interactive notebook. The high multimedia content, strong scientific principles, multiple levels, and humor make this a mystery kids will be eager to crack.

Sleuthing skills of another sort come in handy in **Where in the World is Carmen Sandiego? Junior Detective Edi-**



Kids enjoy a bigtop of fun with Lenny's Multimedia Circus.

they'll find all the usual attractions and circus acts. They may think they're just having fun, but in directing the circus, kids will be learning concepts such as weight and force, how to use money, and more.

Thinkin' Things, Collection 2 (\$40 estimated street price; Edmark Corp., 206-556-8484) takes a more straightforward approach to teaching kids 6 to 12 skills in

critical thinking. Kids familiar with *Thinkin' Things 1* will recognize Oranga Banga and the Fripples, though here they're leading new activities. Oranga now helps kids learn to read and write rhythms, while the Fripples encourage kids to develop their auditory and visual memory. Other games strengthen visual thinking and spatial awareness. Parents can set difficulty levels and monitor their

child's progress, as well as get ideas from a video guide.

Critical thinking appears in a more personal form in **SimTown** (\$40 estimated street price; Maxis, 800-336-2947). This town-building simulation for ages 8 to 12 lets kids build and manage their own town, then interact with the people. Kids can design the character they want to play, follow their character around, or peep at the skateboarding and bicycling denizens of their creation. The fun doesn't end once the burger joints and libraries are in place; kids need to think creatively to keep their Sim-Townies happy and their town thriving.

—Gayle C. Ehrenman

Grades 6-12

Kids in this age range require serious skill-based training that's educationally sound yet still entertaining. These 15 programs meet that need.

Children in the throes of

learning prealgebra will appreciate **Math Blaster Mystery: The Great Brain Robbery** (\$40; Davidson & Associates, 800-545-7677). In this arcade style drill-based program in the popular Blaster line, kids 10 to 15 wander Dr. Dabble's spooky mansion searching for Big Brain's brain. En route, they'll solve prealgebra, logical thinking and word problems dispensed by bizarre characters.

Kids 12 to 18 can join forces with the intrepid Dr. Elaina to help reclaim **The Lost Mind of Dr. Brain** (\$49.95; Sierra On-Line, 800-757-7707). Dr. Brain, an off-beat mad-scientist type, is obsessed with the ancient science of puzzleometry. So it follows that when Dr. Brain's intellect is transferred to his laboratory rat in an experiment gone awry, the only way to reconstruct his brain is to reverse-engineer ten logic puzzles. With a sleek interface, catchy soundtrack, and brain-teasing puzzles that are

Cut and Paste Your Way to an A



If your term paper lacks a certain something—be it a map, a photo, or a really good quote—why not go to the source? Just select something from one of these five CD-ROM reference tools, then bring it into your document using the cut-and-paste functions of the Windows Clipboard. Don't forget to provide proper attribution for those borrowed bits.

If your paper on Mark Twain is just begging for a good quote, turn to **Microsoft Bookshelf '95** (\$80 estimated street price; Microsoft Corp., 800-426-9400). This program includes the complete text of the *Columbia Dictionary of Quotations*, as well as four other reference works—all of which are suitable for cutting and pasting.

If what you need is some biographical information on Twain, turn to **Webster's Interactive Encyclopedia for Windows** (\$59; Attica Cybernetics Ltd., 800-721-2475). This reference work contains more than 34,000 articles from *Hutchinson's Encyclopedia*, as well as a vast array of illustrations, all of which you can cut-and-paste.

Maybe you can't quite explain the sociological implications of *Huckleberry Finn*. Don't say *PC Magazine* told you, but all of the more than 200 study guides on the CD-ROM version of **Monarch Notes for Windows** (\$79.97; Bureau of Electronic Publishing, 800-828-4766) are available for cutting and pasting.

To add an historical perspective,

turn to **Campaigns, Candidates, and the Presidency** (\$39.95; Compton's New Media, 800-862-2206), which provides a myriad of information on each of our 42 Presidents. In addition to more than 700 articles suitable for cutting and pasting, this CD-ROM offers an extensive media gallery.

The perfect finishing touch for that paper on Huck Finn would be a map showing the route of the Mississippi. **The Rand McNally Quick Reference Atlas** (\$24.95; Rand McNally & Co., 800-671-5006) provides five types of maps—including topographical, population, and economic activity—that you can either print or copy through the Windows Clipboard.

—Charles Taft

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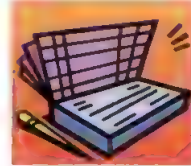
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as challenging as they are fun, this is an intricately crafted game that's guaranteed to give your own brain a good workout. Be warned: this one is so much fun the kids may have to fight you off for a chance to play.

Join the trek Westward with **The Oregon Trail II** (\$50 estimated street price; MECC, 800-685-6322, ext. 529).

This updated version of the original Oregon Trail once again sets explorers 10 to 18 on the path of the pioneers. This version adds photorealistic backdrops and gives you greater flexibility to craft your own journey West, with the option of choosing from a selection of occupations, destinations, and even trails added to the already stellar simulation. While players are exploring landmarks and talking to fellow pioneers, they'll also be sharpening their decision-making skills and learning about the geography of the Old West. To help encourage creative writing skills, pioneers can record the important moments of their trek in a daily journal.

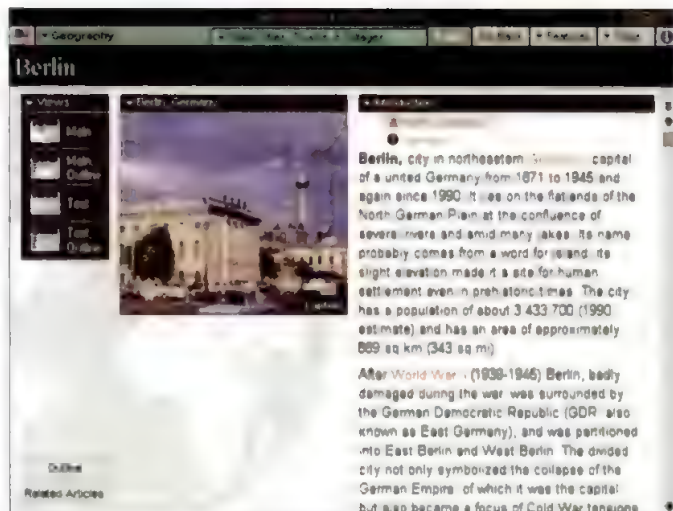
Can't tear your kids away from the TV? Try tuning them into the Interstellar Broadcasting System, home of the **Alien Tales** game show (\$45; Broderbund Software, 800-521-6263). This vibrantly animated CD-ROM for kids 10 to 12 presents its contestants with the challenge of playing against a celebrity panel of aliens claiming to have authored literature originating from the planet Earth. In order to expose these impostors for the frauds that they are, contestants must answer a series of true/false questions

and fill in puzzle answers with information they've acquired through reading passages from an assortment of 30 classic and contemporary children's works, including *The Wizard of Oz*, *Charlotte's Web*, and *The Secret Garden*. Don't worry, though: Kids will have to actually read the book in order to learn how a story ends.

Youngsters and preadolescents will always have a natural curiosity about the facts of life, and **Nine Month Miracle** (\$39.95; A.D.A.M. Software, 800-408-2326) should go far towards satisfying that curiosity. Miracle traces one couple's journey through pregnancy, using animations and videos of real couples to elaborate on the various aspects of having a child. There's a chapter suitable for kids 3 to 9, but the bulk of the material is more appropriate for those 9 to 15. The program includes instructive anatomical diagrams and reference guides, as well as an option for disabling the more explicit explanations, which include videos of childbirth. And as



Solve logic puzzles and win back the Lost Mind of Dr. Brain.



Microsoft Encarta has a sleek interface and interesting articles.

with sibling product A.D.A.M. The Inside Story, parents can lock the fig leaves in place on both the animated Adam and Eve.

Touch-typing skills are invaluable to students, and **Multimedia Typing Instructor** (\$29.95; Individual Software, 800-822-3522) is a fun way for kids 12 and up to develop those skills. This adventure game-like learning tool sets you down in an airport, from which you can embark on an airborne typing adventure. The program includes four levels of lessons that are aimed at everyone

from the beginner who's not familiar with the QWERTY keyboard layout to the expert who wants to improve his speed. There are a host of typing exercises to choose from, as well as typing games, a history of typing, and ergonomic tips.

Make the research for your child's next term paper go a bit smoother with a CD-ROM encyclopedia; the three that follow are perfect for kids 10 to 18. **Microsoft Encarta '95** (\$90 estimated street price; Microsoft Corp., 800-426-9400) has the sleekest interface of the lot. It includes a good mix of articles, photos, and audio and video clips. In addition to these usual multimedia types, Encarta includes a series of InterActivities that guide you through stimulating topics such as Personal Nutrition, World Music, Exploring Fractals, and World Languages. Sort options make it easy for researchers to search across media, category, or area of interest. In addition, Encarta includes such references as an atlas, a dictionary, and a thesaurus.

The 1995 Grolier Multimedia Encyclopedia (\$89 esti-

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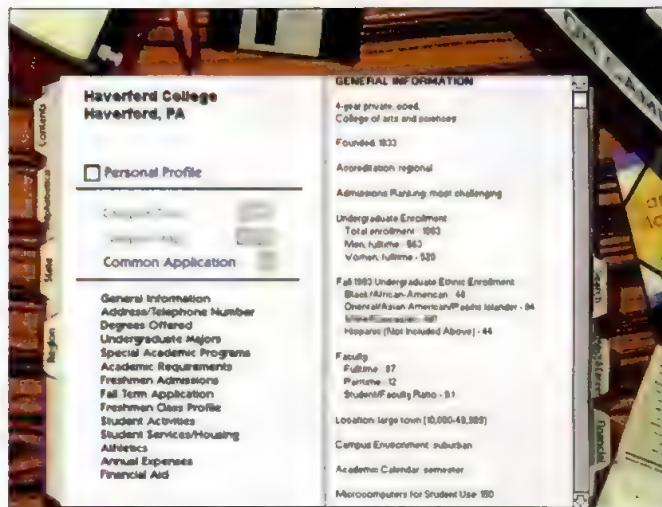
mated street price; Grolier Electronic Publishing, 800-285-4534) is an excellent general-purpose reference tool. Its interface may not be as user-friendly as Encarta's, but its articles are every bit as useful. Of special interest here are sophisticated Timelines, which help put events in a historical and cultural perspective, and a series of Pathmakers, which help you explore a subject, such as The Artist in the Modern Era, as well as a series of multimedia maps.

Compton's Interactive Encyclopedia, 1996 edition (\$80; Compton's New Media, 800-862-2206) has an adjustable interface divided into thirds, so you'll have access to all related media at a glance. Compton's provides such features as an atlas, a time line, and an Infopilot, which links a given topic with connected topics. The program now provides access to America Online via a toolbar button that makes online research easy for new and existing users alike. The Editing Room feature, which allows you to create multimedia presentations using any of the encyclopedia's contents, has been tied more closely to the text of the encyclopedia in this version.

The ultimate productivity tool for students 10 to 15 is **Student Writing & Research Center** (\$99; The Learning Company, 800-852-2255). The Student Writing Center component includes a full-featured word processor, a basic desktop publishing program, clip art, a bibliography maker, grammar and writing tips, and even a password-protected journal. On the research side, the package includes Compton's Concise Encyclopedia,

accessible through a toolbar button that lets you switch between research and writing modes with ease. When you copy text or media from an article in the encyclopedia and paste it into your document, reference citations and copyright information are automatically included in your document, so you'll never run into a plagiarism problem.

If your research is more on the geographical or sociopolitical side, then **PC Globe Maps 'N' Facts** (\$32; Broderbund Software, 800-521-6263) will prove an invaluable source. A world atlas, fact book, and almanac combined in one, Maps 'N' Facts allows kids 10 and up to view maps of



Choosing a college just got easier, thanks to On Campus 96.

227 countries in a variety of contexts, including by topography, statistics, and political grouping (both current and extinct). The program also lets you create a customized

map or statistical report comparing countries by a variety of categories, including everything from economics, manufacturing, and demographics to exchange rates.

Choosing the Best PC to Take Back to School



Late summer has become the second-hottest selling season for personal computers. With the cost of four years of private college pushing \$100,000, what's another \$2,000 for a tool that might help you nudge that B plus up to an A minus? And for younger students still in high school or grade school, the PC might just help in getting into the college of choice.

If you're interested in buying a PC, consider:

- Your best deal is a PC-compatible desktop computer that costs about \$2,000.
- Laptops make a lot of sense for college students living in cramped dorm rooms. But be forewarned: You'll pay \$500 to \$1,000 more for a laptop than you would for a desktop with equivalent computing power. When you're buying that laptop, be sure you buy a locking cable, too; portable often translates to theft-prone.
- If your school uses Macintoshes exclusively, you should consider them, as long as you realize you'll be paying a bit more than you

would for a Windows-compatible PC.

No matter how cost-constrained you may be, don't consider anything less than a system with a Pentium processor, 8MB of RAM, a data/fax modem, a 540MB hard disk, and a CD-ROM drive. With a 15-inch monitor, a sound card, and a pair of speakers, you should be able to find a system you like for about \$2,000. If you don't have a printer yet, look for a PC bundle that includes a color ink jet printer for an additional \$200 to \$400.

Most home-oriented PCs come with 15 to 40 bundled software titles, typically worth \$1,000 to \$2,000 if you were to buy them separately. They'll give you the fundamental applications for word processing, spreadsheets, graphics, and communications, as well as a couple of games and some general-reference works.

Consider buying your PC via mail order or from a local dealer; college buying plans no longer save you much. Macs are still sometimes cheaper through a college, though.—*Bill Howard*

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And if you think that's a deal, consider the popular **ScanMaker II** for only **\$399!**

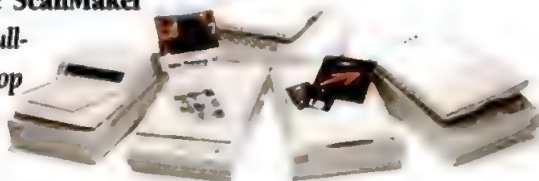


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Back-to-School Software by Age and Subject



Those interested in learning more about the environment will want to look at **Earth Explorer** (\$56 estimated street price; Interactive, 800-452-9999). This multimedia reference tool for ages 10 to 15 provides hundreds of articles on how the physical world functions, as well as on environmental issues such as acid rain, global warming, and hazardous waste. There are scads of multimedia elements, too; but what sets Earth Explorer apart are the interactive data sets that allow you to play "what if" games on 21 different environmental topics.

Obtaining a learner's permit is one of the most highly anticipated rites of passage for teenagers 14 to 18, and **License to Drive** (\$39.95; Janus Interactive, 800-766-0835) is the perfect companion to help kids pass their permit test with flying colors. This CD-ROM is packed with important information describing the rules of the road, ranging from signs and signals to defensive driving tips and details about the dangers of driving while intoxicated. Animations are used to illustrate a variety of driving scenarios, putting those ordinary books from the DMV to shame.

Before high schoolers 13 to 18 can devote themselves to thoughts of proms and campus life, they'll have to first plot the route to college. The first stop is passing the SAT. **Team SAT** (\$29.95; Zelos Digital Learning, 800-345-6777) provides an affordable, interactive way of preparing for that test. The course, which was prepared by a team of instructors who have had experience teaching SAT prep classes, offers test-taking strategies, study tips, ten simulated and timed exams, and more than

Back to School: College and Beyond

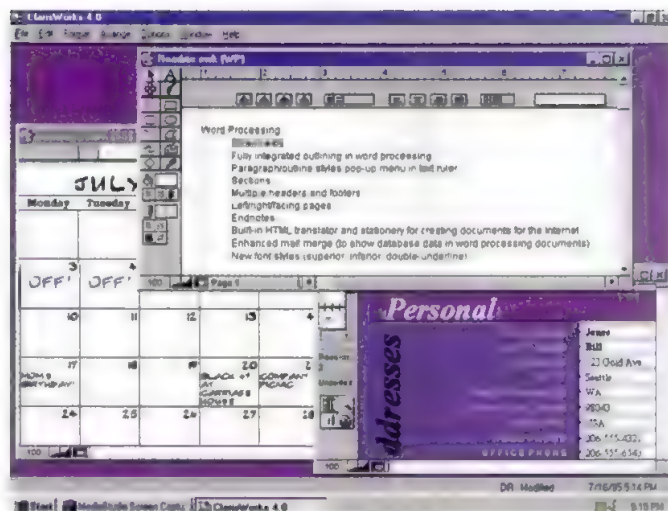
1,300 math and verbal practice questions, presented by a series of encouraging video guides.

The process of applying to college can be equally stressful, but **On Campus 96** (\$49.95; Kaplan InterActive, 212-752-1840) can help relieve much of that pressure. This series of five CD-ROMs provides a complete guide to more than 1,700 colleges nationwide; 300 of the colleges are treated to a multimedia tour of the campus. Kaplan tapped the College Board's databases, so kids 13 to 18 will find everything from admissions requirements to recent class profiles, details about campus life, and campus maps. There are even details about majors offered, planning for a career, and financing your education. Best of all, **On Campus** includes an electronic version of the Common Application, which is accepted at 150 schools. All of this serious content is presented in an adventure game context that makes the program fun to use.—*Melissa J. Perenson*

College and Beyond

Whether you're still cranking on your required courses or looking forward to your days in the work force, these ten programs can help you make the grade.

To make sure you get an A on that final term paper, you'll want to keep a good dictionary handy. **Merriam-Webster's Collegiate Dictionary, Deluxe Electronic Edition on CD-ROM** (\$70 estimated street price; Merriam-Webster, 413-734-3134) includes



ClarisWorks 4.0 provides grads with a suite of applications.

over 160,000 entries as well as a 130,000-word thesaurus, plus 1,000 illustrations and tables. A powerful search engine lets you search by individual fields, combine fields in

a single search, or perform Boolean searches. In your down time, you can use the dictionary's special puzzle solving tools to find the missing word in your crossword puzzle, or play one of the included word games.

You may need reference tools for more than vocabulary-building, however. For biology students, **A.D.A.M. Standard Student Edition** (\$149; A.D.A.M. Software, 800-408-2326) is an interesting and useful resource that can help them ace that human anatomy course. The content here is tied directly to undergraduate anatomy courses. More than 250 detailed illustrations and anatomical models plus thousands of structure identifiers let students dissect and discover the human body from the comfort of their own dorms.

If you need help with your geography (what if you want to do a semester abroad in Cork but aren't sure what

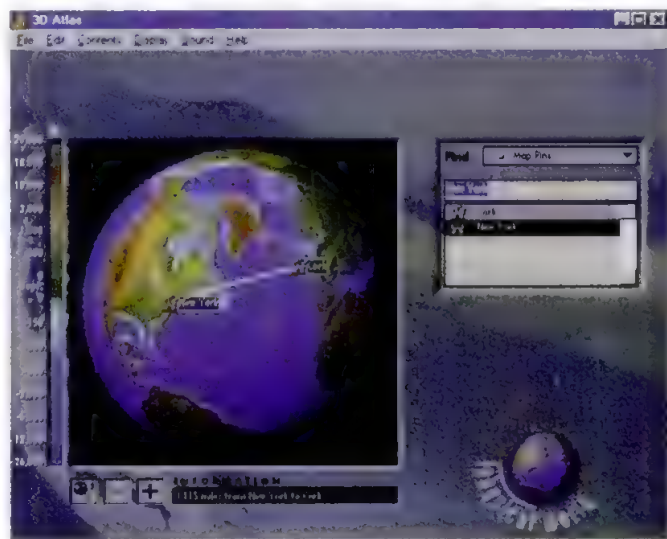
country it's located in?), try **3D Atlas** (\$65; Creative Wonders, 800-245-4525). This multimedia extravaganza literally puts the whole world at your fingertips. In addition to an array of global views, 3D Atlas includes descriptions of most countries and places in the world along with several video clips and animated "flybys."

Another powerful reference tool is Future Vision's **Infopedia** (\$69.99; Future Vision, 516-482-0088). This electronic resource kit contains eight extensive reference works including *Funk & Wag-*

nall's Encyclopedia, *Webster's New Biographical Dictionary*, and the *Hammond World Atlas*. A friendly interface provides easy access to each of these resources, or all eight at once.

Now that you've finished doing the research, it's time to write that paper. For that, you'll want to consider a software suite. **ClarisWorks 4.0 for Windows 95** (\$99 estimated street price; Claris Corp., 408-987-7000), and **Microsoft Works for Windows 95, Version 4.0** (\$99 estimated street price; Microsoft Corp., 800-426-9400) are excellent choices for the student and can even come in handy in the business world. Both packages include word processing, spreadsheet, and database applications, as well as a host of other tools and utilities. Also, both ClarisWorks and Microsoft Works are designed specifically for Windows 95.

The first—and typically most important—thing you need after college is a job, and that means you need a resume. Thanks to **The Perfect Resume** (\$50; Davidson & Associates, 800-545-7677) you can put together a strong



3D Atlas offers some of the most beautiful maps ever on CD-ROM.

Five Utilities Every Parent Should Have



Your kids may spend more time at the PC than you do, but it's up to you to make sure the computing experience is a rewarding one for the whole family. These five utilities will make that job a little easier for you.

To keep your hard disk safe from junior computer whizzes, try **KidDesk Family Edition** (\$29.99; Edmark Corp., 800-426-0856). This desktop manager provides each family member with his own customized, password-protected desktop, complete with programs chosen for him. Parents can set security options so that KidDesk launches automatically or so that kids can't exit from KidDesk to roam around the hard disk. The program also includes a handful of accessories and an internal e-mail system.

Link your kid to cyberspace with

KidMail Connection (\$24.95 floppy disks, \$19.95 CD-ROM; ConnectSoft, 800-889-3499). This program may sport a cartoon-style interface, but it can seamlessly connect your child to the e-mail capabilities of Prodigy, CompuServe, or MCIMail. Kids choose the environment they want to write, send, and receive mail from, and set their own passwords; parents can issue "stamps" that determine how many e-mail messages each child may send.

If your kids spend too much time shooting down mutants and not enough doing homework, the solution is **Time's Up!** (\$39.95; The Fresh Software Company, 800-846-3787). This program lets you set a time limit for when and how long your child can play games. Two minutes before time's up, the program gives kids a warning; when the clock

runs out, Time's Up shuts the game down.

To make your time a little easier to manage, consider the **Peanuts Family Organizer for Windows** (\$19.95; Individual Software, 800-822-3522). This personal information manager, which stars the Peanuts gang, lets you create family-wide and individual schedules, address books, and to-do lists. You can even use the software to leave messages for other family members.

If your printing needs run a bit deeper, you'll want to take a look at **The Print Shop Deluxe CD Ensemble** (estimated street price \$80; Broderbund Software, 800-521-6263). This single CD-ROM provides templates and graphics for creating greeting cards, calendars, labels, banners, and stationery that will rival anything you can find in a store.—Charles Taft

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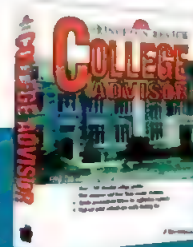


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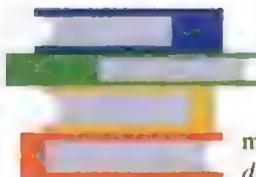
Tom Jackson.

Perhaps job-hunting isn't for you—yet. Going back to school for a higher degree is always a viable option, but first you have to take an admissions test. Spend some time practicing with **Score-Rx for the GRE, Windows Ver-**

sion (\$99 estimated street price; Xenon Educational Systems, 305-345-9209) and you may find

that test a little less intimidating. Score-Rx, which is also available for the ACT, GMAT, LSAT, and the SAT, lets you take several sample tests and see what your score might be on the real thing. A tutor mode is also included to provide helpful feedback on your performance.

Regardless of which option you find most appealing, chances are that a well-rounded knowledge of computers will come in handy. That's where **PC Library** (\$99.95; Allegro New Media, 800-424-1992) comes in. This CD-ROM contains 46 popular reference books on a variety of computer topics. The titles range from *The Complete*

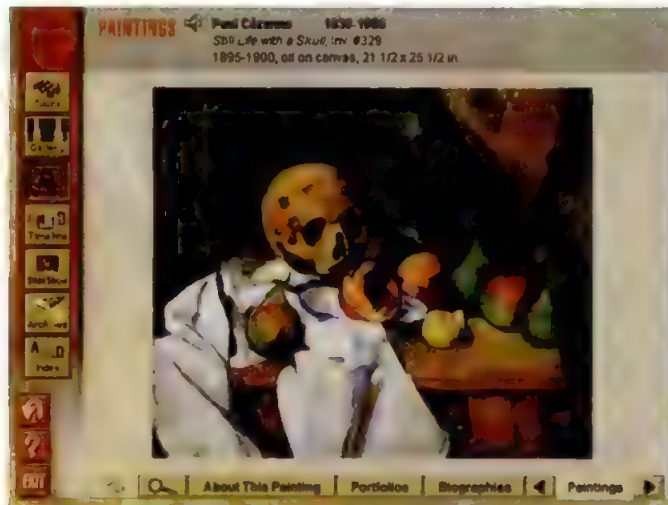


Idiot's Guide to the Internet to Jim Seymour's *PC Productivity Bible*.

This package also includes audio and video clips to help illustrate key points.

Finally, once you get out into the work force, you should never forget to enjoy the finer things in life. **A Passion for Art: Renoir, Cezanne, Matisse, and Dr. Barnes** (\$60 estimated street price; Corbis Corp., 800-260-0444) is definitely one of those finer things. This incredible CD-ROM gives you an exclusive tour of one of the world's most impressive art galleries. A well-designed interface and beautifully recreated paintings combine to make *A Passion for Art* a truly worthwhile product for any art lover.

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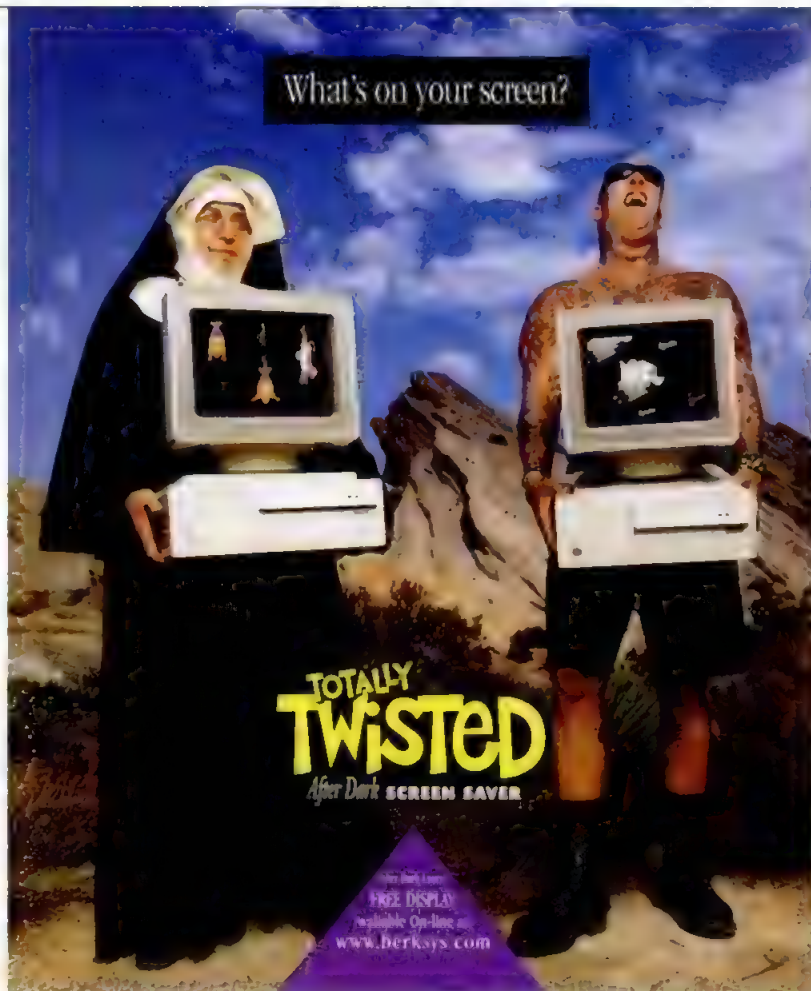
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Advertisers' Index COMPANIES

Reader Service No.	Advertiser	Page
910	3M Data Storage Products	14-15
378	7th Level	392
*	Acer America	77-81
218	Adaptec	180
226	ADI Systems Inc	60
047	Adobe Systems Inc	250
196	Alpha Software Corporation	380
162	American Power Conversion	377
364	American Small Business Computers	28
235	AMS	322-323
*	Apple Computers	139
*	Apple Computers	141
336	ARLINGTON COMPUTER PRODUCTS	310
254	Artisoft Inc	26-27
*	AT&T	156-157
127	ATI Technologies Inc	255
012	Austin Direct	133-135
393	Berkeley Systems	393
292	Caere Corporation	6
245	Caere Corporation	247
*	Canon Computer Systems	64-65
095	Colorado Memory Systems	13
*	Communication Intelligence	76
*	Compaq Computer Corporation	70-71
*	Compaq Computer Corporation	106-107
*	Compaq Computer Corporation	186-187
387	CompuLink Research	98-99
144	CompUSA Direct	336-337
348	Computer Associates	2-3
360	COMPUTER DISCOUNT WAREHOUSE	326-327
109	COMPUTER DISCOUNT WAREHOUSE	328-329
158	Computer Library	259-261
007	Connectix	243
224	Conner Peripherals	23
322	Corel Corporation	41
037	Corel Corporation	155
314	Corel Corporation	238
042	Corel Corporation	277
358	Corel Corporation	383
101	Creative Computers	312-313
286	CTX International	253
*	Dell Computer Corporation	34-35
*	Dell Computer Corporation	84
*	Dell Computer Corporation	174-175
*	Dell Computer Corporation	216
*	Dell Computer Corporation	C5-C8
316	Delrina Technology	18
176	Diamond Multimedia Systems	96
388	Digital Equipment Corporation	86-87
396	Discovery Networks	372-373
201	DTK Computer	233
851	Ecel Systems Corp	NE73
875	Emulex Network Systems	NE16
*	Epson America	10-11
354	Ergo Computing, Inc	296
075	First Source International	290
014	First Source International	291

Reader Service No.	Advertiser	Page
272	First Source International	292-293
861	FTP Software Inc	NE61
179	Fujitsu Computer Products	68
*	Gateway 2000	48A-49
*	Gateway 2000	207-210
879	Gupta Technologies, Inc	NE13
062	HARTFORD COMPUTER GROUP	289
136	Hayes Microcomputer Products	171
*	Hewlett Packard	58-59
*	Hewlett Packard	142-143
*	Hewlett Packard - Colorado	NE24-NE25
170	Hyundai Electronics America	375
*	IBM Corporation	52-53
*	IBM PC Corporation	145
*	IBM PC Corporation	147
*	IBM PC Corporation	149
*	IBM Corporation	NE14-NE15
219	Insight Direct	324-325
027	Insight Direct	368
*	Intel Corporation	202-203
*	Intel Corporation	NE23
383	Janna Systems	67
921	Kingston Technology	NE51
019	L.A. Trade	302-303
*	Lotus Development Corporation	72-73
*	Lotus Development Corporation	NE27-NE46
067	MAG Innovision	256
083	Magitronic	309
015	Magnavox	20-21
365	Manugistics, Inc	22
124	Matrox, Inc	33
018	MegaHaus	335
321	Megahertz Corp	5
855	Micro Solutions Computer Products	305
107	Microcom	182
893	Microcom	NE8-NE9
862	Microcom	NE58
391/138	MicroMall Direct	297
119	Micron Computer, Inc	163-168
203	Micron Computer, Inc	311
924	Micron Computer, Inc	NE2-NE3
*	Microsoft	C2-1
*	Microsoft	160-161
*	Microsoft	NE62-NE63
*	Microsoft	NE65
091	Microtek	385
010	Midwest Computer Works	306-307
398	Midwest Micro	331-334
367	Motorola	391
177	MPC Technology, Inc	301
217	NEC Technologies	16-17
908	NEC Technologies	NE18
877	NetManage, Inc	NE71
*	Novell, Inc	NE11
881	Novell, Inc	NE49
*	Okidata	82
*	Oracle Corp	NE5

Reader Service No.	Advertiser	Page
926	Palindrome	NE20
*	PC Connection	320-321
080	PC Power & Cooling	94
092	PCs Compleat	314-315
268	PCs Compleat	316-317
053	PerComp Microsystems, Inc	298-299
867	Performance Technology	NE78
928	Perle Systems	NE69
853	Persoft	NE56
098	Pinnacle Micro	43
345	Powersoft Corporation	249
148	Primavera Systems	45
168	Princeton Review	390
056	Pro Direct	287
*	Prodigy Services Co	193-194
904	Quarterdeck Office Systems	235
309	S.A.G./Storage Solutions	231
256	SCEPTRE Technologies	387
271	Seagate Technology	151
*	Sharp Electronics Corp	237
150	SmartPrint/Dresselhaus	181
013	Smile International	381
285	Softbanks Expos	264
359	Softbanks Expos	279
355	Softbanks Expos	367
043	SPSS, Inc	330
*	STAC Electronics	213
*	STAC Electronics	215
*	Standard Microsystems Corporation	NE53
*	Standard Microsystems Corporation	NE55
057	StatSoft	55
081	Sunshine Computers	294
186	Symantec Corporation	109-111
171	Symantec Corporation	113
174	Symantec Corporation	115
173	Symantec Corporation	117
873	Symplex Communications Corp	NE7
001	Tektronix Inc	74
304	Texas Instruments	100-101
353	Texas Instruments	189
246	Texas Instruments	227
916	TGV Inc	NE67
379	Toshiba America	118-119
*	Touche	90
920	US Robotics Inc	36
210	USA Flex	318-319
239	Viking Components	92
006	Visio	267
237	Western Digital	57
085	WinBook Computer Corporation	63
211	Xircom	179
338	ZD Net	271-275
*	Zenith Data Systems	198-199
151	Zeos Int'l	24-25
038	Zeos Int'l	88
155	Zeos Int'l	121-126

* No Reader Service #. Please Call Advertiser For Information

Advertisers' Index PRODUCTS

Reader Service No.	Company	Product	Page	Reader Service No.	Company	Product	Page
ACCELERATOR BOARDS				EDUCATIONAL SOFTWARE			
176	Diamond Multimedia Systems	Stealth 64	96	393	Berkeley Systems	Totally Twisted	393
124	Matrox, Inc.	MGA Millennium	33	ELECTRONIC MAIL			
ADD-ON BOARDS				881	Novell, Inc.	GroupWise	NE49
*	Intel Corporation	Intel Adapters	NE23	EMULATORS/PROTOCOL CONVERTERS			
124	Matrox, Inc.	MGA Millennium	33	853	Parsoft	Smartem	NE58
391/138	MicroMail Direct	Memory PCMCIA	297	ENTERTAINMENT SOFTWARE			
ANTI-VIRUS SOFTWARE				378	7th Level	Battle Beast	392
*	Microsystems Corporation	Q3 Promotion - Free Utility	NE55	393	Berkeley Systems	Totally Twisted	393
APPLE PRODUCTS				FAX/MODEM			
*	Apple Computers	Apple Corporation	139	075	First Source International	Notebooks, Memory Peripherals	290
*	Apple Computers	Apple Corporation	141	272	First Source International	Memory Software, Notebooks	292-293
BACKUP SOFTWARE				179	Fujitsu Computer Products	PC Card	68
855	Micro Solutions Computer Products	Tape Backup	305	321	Megahertz Corp.	XLJack PCMCIA V.34 Modem	5
BRIDGES/ROUTERS/GATEWAYS				893	Microcom	LAN Express	NE8-NE9
873	Symplex Communications Corp.	DirectRoute	NE7	862	Microcom	HDMS	NE58
CAD/CAM				081	Sunshine Computers	Notebooks/Laptops	294
364	American Small Business Computers	Design CAD 2D	28	211	Xircom	Modems	179
CD-ROM				FLOWCHARTING			
158	Computer Library	Computer Select	258-261	006	Visio	Visio Graphics Software	267
354	Ergo Computing, Inc.	CD ROM Notebook	296	GRAPHICS SOFTWARE			
272	First Source International	Memory Software Notebooks	292-293	292	Caere Corporation	OmniPage	5
219	Insight Direct	Mail Order	324-325	*	Sharp Electronics Corp.	LCD Projection Panels	237
027	Insight Direct	Mail Order	368	006	Visio	Visio Graphics Software	267
855	Micro Solutions Computer Products	CDROM	305	HAND-HELD PC'S			
*	STAC Electronics	Quick Share	213	217	NEC Technologies	Notebooks	18-17
CHIPS/PROCESSORS				HARD DRIVES			
272	First Source International	Memory Software, Notebooks	292-293	224	Conner Peripherals	Disk Drives	23
019	Intel Corporation	Pentium	202-203	014	First Source International	Peripherals Software Notebooks	291
391/138	L.A. Trade	Memory	302-303	219	Insight Direct	Mail Order	324-325
	MicroMail Direct	Memory PCMCIA	297	027	Insight Direct	Mail Order	368
CO-PROCESSORS				855	Micro Solutions Computer Products	Disk Drives	305
*	Intel Corporation	Intel Adapters	NE23	056	Pro Direct	Mail Order	287
COMMUNICATIONS SOFTWARE				237	Western Digital	Cable	57
318	Dekra Technology	Communications	19	HARDWARE			
861	FTP Software Inc.	Explore On Net	NE61	*	Apple Computers	Apple Corporation	139
107	Microcom	Carbon Copy	182	*	Apple Computers	Apple Corporation	141
877	NetManage, Inc.	Chameleon 4.5	NE71	387	Canon Computer Systems	Canon Scanners	84-85
881	Novell, Inc.	GroupWise	NE49	144	CompuLink Research	Infinity	98-99
	STAC Electronics	ReachOut	215	101	CompuLink Research	Mail Order	336-337
186	Symantec Corporation	Windows 95 - Launch	109-117	286	Creative Computers	Hardware	312-313
171	Symantec Corporation	Win 95 - NU	113		CTX International	20" Monitor	253
174	Symantec Corporation	Win 95 - NAV	115		Dell Computer Corporation	Dell Notebook Computers	34-35
173	Symantec Corporation	Win 95 - Navigator	117		Dell Computer Corporation	Dell Notebook Computers	84
COMPUTERS/COMPUTABLES					Dell Computer Corporation	Dell Dimension	174-175
338	Acer America	PCs	77-81		Dell Computer Corporation	Dell Dimension	216
012	ARLINGTON COMPUTER PRODUCTS	Peripherals	310	178	Diamond Multimedia Systems	Stealth 64	96
	AT&T	AT&T Globalyst PC	156-157	388	Digital Equipment Corporation	PCs	86-87
	Austin Direct	Austin Desktops	133-135	136	Hayes Microcomputer Products	Optima PCMCIA	171
	Compaq Computer Corporation	Portables	70-71		IBM PC Corporation	Thinkpad	145
	Compaq Computer Corporation	Notebooks	106-107	921	IBM PC Corporation	Commercial Desktops	147
	Compaq Computer Corporation	Desktops	186-187	015	IBM PC Corporation	Commercial Desktops	149
387	CompuLink Research	Infinity	98-99	018	Kingson Technology	Storage	NE51
144	CompuLink Research	Mail Order	336-337	321	Magnavox	Magnavox Monitors	20-21
360	COMPUTER DISCOUNT WAREHOUSE	Hardware	326-327	893	Megahertz Corp.	Drives/Storage	335
109	COMPUTER DISCOUNT WAREHOUSE	Hardware	328-329	862	Megahertz Corp.	XLJack PCMCIA V.34 Modem	5
	Dell Computer Corporation	Dell Notebook Computers	34-35	091	Microcom	LAN Express	NE8-NE9
	Dell Computer Corporation	Dell Notebook Computers	84	398	Microcom	HDMS	NE58
	Dell Computer Corporation	Dell Desktops	C5-C8		Microtek	Scanners	385
	Dell Computer Corporation	Dell Dimension	174-175	217	Midwest Micro	Notebooks, Desktops, Peripherals	331-334
	Dell Computer Corporation	Dell Dimension	216	080	NEC Technologies	Notebooks	18-17
388	Digital Equipment Corporation	PCs	86-87	056	PC Power & Cooling	PowerProtection/Cooling Devices	94
201	DTK Computer	Dum V-3	233	309	Pro Direct	Mail Order	287
	Gateway 2000	PCs	207-210	256	S.A.G./Storage Solutions	Peripherals	231
062	GATEWAY 2000	PCs	48A-49	211	SCEPTRE Technologies	Notebook	387
	HARTFORD COMPUTER GROUP	Mail Order	289		Xircom	Modems	179
	Hewlett Packard	HP Vectra PCs	58-59	HUBS			
	Hewlett Packard	HP NetServers	142-143		Standard Microsystems Corporation	Hubs	NE53
	IBM PC Corporation	Thinkpad	145	INFORMATION MANAGERS			
	IBM PC Corporation	Commercial Desktops	147	345	Powersoft Corporation	Information Management Software	249
	IBM PC Corporation	Commercial Desktops	149	INPUT DEVICES			
219	Insight Direct	Mail Order	324-325	*	Communication Intelligence	Handwriter for Windows	76
027	Insight Direct	Mail Order	368	*	Epson America	Personal Document Station	10-11
	Intel Corporation	Pentium	202-203	*	Touche	Touche Touch Pad	90
083	Magitronic	Magitronic Desktop System	309	LAN ADAPTER BOARDS			
119	Macron Computer, Inc.	Macron PCs	163-168	218	Adaptec	SCSI Adapter Boards	180
010	Midwest Computer Works	PCs	306-307	*	Intel Corporation	Intel Adapters	NE23
398	Midwest Micro	Desktop Systems	331-334	LAPTOPS/PORTABLE COMPUTERS			
217	NEC Technologies	Notebooks	18-17	*	Acer America	Notebooks	77-81
092	PCs Complete	Mail Order	314-315	235	AMS	Notebooks	322-323
268	PCs Complete	Mail Order	316-317	012	Austin Direct	Austin Notebooks	133-135
053	PerComp Microsystems, Inc.	Mail Order	298-299		Compaq Computer Corporation	Portables	70-71
309	S.A.G./Storage Solutions	Peripherals	231		Compaq Computer Corporation	Notebooks	106-107
379	Toshiba America	Notebook Computers	118-119	144	CompuLink Research	Mail Order	336-337
210	USA Flex	Desktops	318-319	360	COMPUTER DISCOUNT WAREHOUSE	Laptops	326-327
038	Zeos Int'l	Zeos AMBRA Server	88	109	COMPUTER DISCOUNT WAREHOUSE	Laptops	328-329
155	Zeos Int'l	Zeos Pentium PCs	121-126		Dell Computer Corporation	Dell Notebook Computers	34-35
DATA BASE MANAGERS					Dell Computer Corporation	Dell Notebook Computers	84
198	Alpha Software Corporation	Home Suite	380		Dell Computer Corporation	Dell Notebook Computers	C5-C8
879	Gupta Technologies, Inc.	Client/Server Database	NE13	201	DTK Computer	Dum V-3	233
*	IBM Corporation	Data Management Capabilities	52-53	851	Ecal Systems Corp.	Powerisers 7500-series	NE73
*	Microsoft	Microsoft Visual Fox Pro	NE62-NE63	354	Ergo Computing, Inc.	CD ROM Notebook	296
*	Microsoft	Microsoft Visual Fox Pro	NE65	075	First Source International	Notebooks, Memory Peripherals	290
*	Oracle Corp.	Workgroup 2000	NE5		Gateway 2000	Notebooks	207-210
DATA COMPRESSION SOFTWARE					Gateway 2000	Notebooks	48A-49
007	Connectix	RAM Doubler	243	062	HARTFORD COMPUTER GROUP	Mail Order	289
DEMONSTRATION SOFTWARE					IBM PC Corporation	Thinkpad	145
*	Sharp Electronics Corp.	LCD Projection Panels	237		Megahertz Corp.	XLJack PCMCIA V.34 Modem	5
DISK BACKUP & TAPE DRIVES				321	Midwest Computer Works	Hardware	306-307
910	3M Data Storage Products	3M Data Storage Products	14-15	010	Midwest Micro	Notebooks	331-334
*	Hewlett Packard - Colorado	HP DAT	NE24-NE25	177	MPC Technology, Inc.	MultiMedia Notebooks	301
855	Micro Solutions Computer Products	Tape Backup/Disk Drives	305	217	NEC Technologies	Notebooks	18-17
926	Palindrome	Tape Backup	NE20	256	SCEPTRE Technologies	Notebook	387
DISPLAYS/MONITORS				081	Sunshine Computers	Notebooks/Laptops	294
226	AD Systems Inc.	Monitors	60	304	Texas Instruments	Portables	100-101
286	CTX International	20" Monitor	253	353	Texas Instruments	Portables	189
014	First Source International	Peripherals Software Notebooks	291	246	Texas Instruments	Portables	227
067	Hyundai Electronics America	Monitors	375	379	Toshiba America	Notebook Computers	118-119
167	MAG innovation	MAG Innovation Monitors	256	210	USA Flex	Notebooks	318-319
015	Magnavox	Magnavox Monitors	20-21	005	WinBook Computer Corporation	Winbook	63
010	Midwest Computer Works	Monitors	306-307		Zenith Data Systems	Z-Notebook #1	198-199
*	Sharp Electronics Corp.	LCD Projection Panels	237	151	Zeos Int'l	Mandian Color Notebooks	24-25
013	Smith International	Monitors	381	038	Zeos Int'l	Zeos AMBRA Server	88
LOCAL AREA NETWORKING				348	Computer Associates	Openings	2-3

Advertisers' Index PRODUCTS

Reader Service No.

Reader Service No.	Company	Product	Page
360	COMPUTER DISCOUNT WAREHOUSE	Networking Products	326-327
109	COMPUTER DISCOUNT WAREHOUSE	Networking Products	328-329
316	Delrina Technology	Communications	18
975	Emulex Network Systems	ConnectPlus LT	NE18
951	FTP Software Inc.	Explore On Net	NE61
062	HARTFORD COMPUTER GROUP	Mail Order	289
	Intel Corporation	Intel Adapters	NE23
893	Microcom	LAN Express	NE8-NE9
862	Microcom	NetBMS	NE58
908	NEC Technologies	NEC Servers	NE18
	Novell Inc.	Novell Netware 4.1 Upgrade	NE11
867	Performance Technology	Instant Internet	NE78
928	Perle Systems	Perle 833-Remote Access Server	NE69
853	Perisoft	Smartterm	NE56
	STAC Electronics	Quick Share	213
	STAC Electronics	ReachOut	215
	Standard Microsystems Corporation	Hubs	NE53
	Standard Microsystems Corporation	Q3 Promotion - Free Utility	NE55

MAIL ORDER

235	Acer America	PCs and Notebooks	77-81
	AMS	Notebooks	322-323
336	ARLINGTON COMPUTER PRODUCTS	Mail Order	310
	AT&T	AT&T GlobalVist PC	156-157
012	Austin Direct	Austin Desktops and Notebooks	133-138
	Compaq Computer Corporation	Notebooks	108-107
	Compaq Computer Corporation	Desktops	186-187
387	ComputLink Research	Infinity	88-89
144	CompUSA Direct	Mail Order	336-337
360	COMPUTER DISCOUNT WAREHOUSE	Resellers	326-327
109	COMPUTER DISCOUNT WAREHOUSE	Resellers	328-329
201	DTK Computer	Quant V.3	233
272	First Source International	Memory Software, Notebooks	292-293
	Gateway 2000	Mail Order	207-210
	Gateway 2000	Mail Order	48A-49
062	HARTFORD COMPUTER GROUP	Mail Order	289
219	Insight Direct	Mail Order	324-325
027	Insight Direct	Mail Order	368
083	Magnetron	Magnetron Desktop System	309
391/138	MicroMail Direct	Memory PCMCIA, Fax/Modem, LAN	297
010	Midwest Computer Works	Mail Order	306-307
	PC Connection	Mail Order	320-321
092	PCs Complete	Mail Order	314-315
268	PCs Complete	Mail Order	316-317
053	PerComp Microsystems, Inc.	Mail Order	298-299
056	Pro Direct	Mail Order	287
081	Sunshine Computers	Notebooks/Laptops	294
210	USA Flex	Notebooks/PCs/Peripherals	318-319
151	Zeos Int'l	Meridian Color Notebooks	24-25
038	Zeos Int'l	Zeos AMBA Server	86
155	Zeos Int'l	Zeos Pentium Pentium PCs	121-126

MAINTENANCE

	Standard Microsystems Corporation	Q3 Promotion - Free Utility	NE55
--	-----------------------------------	-----------------------------	------

MASS STORAGE

095	Colorado Memory Systems	Mass Storage	13
	Hewlett-Packard - Colorado	HP DAT	NE24-NE25
021	Kingston Technology	Storage	NE51
018	MegaHaus	Drives/Storage	335
271	Seagate Technology	Hard Drives	151

MEMORY

007	Connectix	RAM Doubler	243
075	First Source International	Notebooks, Memory, Peripherals	290
272	First Source International	Memory Software, Notebooks	292-293
019	L.A. Trade	Memory	302-303
391/138	MicroMail Direct	Memory	297
203	Micron Computer Inc.	Micron Memory	311
056	Pro Direct	Mail Order	287
239	Viking Components	Memory	92

MISCELLANEOUS

855	Micro Solutions Computer Products	Tape Backup, CDROM, Disk Drives	305
168	Princeton Review	Princeton Review Course	390
916	TGV Inc.	TCP/IP for Windows	NE67
	Touche	Touche Touch Pad	90

MODEMS

179	Fujitsu Computer Products	PC Card	68
136	Hayes Microcomputer Products	Optima PCMCIA	171
321	Megahertz Corp.	X-Jack PCMCIA V.34 Modem	5
367	Motorola	Motorola Modems	391
056	Pro Direct	Mail Order	287
920	US Robotics Inc.	Courier	36
211	Xircom	Modems	179

MULTI-MEDIA

	Apple Computers	Apple Corporation	139
	Apple Computers	Apple Corporation	141
101	Creative Computers	Software	312-313
176	Diamond Multimedia Systems	Stealth 64	96
	Epson America	Personal Document Station	10-11
062	HARTFORD COMPUTER GROUP	Mail Order	289
219	Insight Direct	Mail Order	324-325
027	Insight Direct	Mail Order	368
018	MegaHaus	Drives/Storage	335
177	MPC Technology Inc.	Multimedia Notebooks	301
	Sharp Electronics Corp.	LCD Projection Panels	237

MULTIMEDIA SOFTWARE

322	Corel Corporation	CD Office Companion	41
037	Corel Corporation	Draw 8	155
314	Corel Corporation	Family of Products	238
042	Corel Corporation	Wild Board Games	277
358	Corel Corporation	Movie Guide	383

NETWORK INTERFACE CARDS

179	Fujitsu Computer Products	PC Card	68
	Intel Corporation	Intel Adapters	NE23
056	Pro Direct	Mail Order	287

NETWORKING SOFTWARE

254	Artisoft Inc.	Power Suite	26-27
861	FTP Software Inc.	Explore On Net	NE61
878	Gupta Technologies Inc.	Client/Server Database	NE13
	IBM Corporation	Data Management Capabilities	52-53
	IBM Corporation	Networking	NE14-NE15
	Novell Inc.	Novell Netware 4.1 Upgrade	NE11
	Oracle Corp.	Workgroup 2000	NE5
867	Performance Technology	Instant Internet	NE78
928	Perle Systems	Perle 833-Remote Access Server	NE69
853	Perisoft	Smartterm	NE56
904	Quarterdeck Office Systems	QEMM	235
	STAC Electronics	Quick Share	213
	Standard Microsystems Corporation	Q3 Promotion - Free Utility	NE55
873	Symplex Communications Corp.	DirectRoute	NE7

OCR PRODUCTS

245	Caere Corporation	WordScan	247
	Epson America	Personal Document Station	10-11

Reader Service No.

Reader Service No.	Company	Product	Page
		ON LINE DATABASE	
396	Discovery Networks	Discovery Channel On-Line	372-373
	Prodigy Services Co.	Prodigy On Line Services	193-194
338	ZD Net	ZD NET AT&T Interchange	271-275

OPERATING SYSTEMS

254	Artisoft Inc.	Power Suite	26-27
	Microsoft	Microsoft Windows 95	160-161
	Novell Inc.	Novell Netware 4.1 Upgrade	NE11

OPTICAL PERIPHERALS

018	MegaHaus	Drives/Storage	335
098	Pinnacle Micro	Optical Drives	43

ORGANIZATIONAL SOFTWARE

008	Visio	Visio Graphics Software	267
-----	-------	-------------------------	-----

OS/2 SOFTWARE

	IBM Corporation	Networking	NE14-NE15
--	-----------------	------------	-----------

PC ACCESSORIES

855	Micro Solutions Computer Products	Tape Backup, CDROM, Disk Drives	305
-----	-----------------------------------	---------------------------------	-----

PC DIRECT

235	AMS	Notebooks	322-323
336	ARLINGTON COMPUTER PRODUCTS	Mail Order	310
144	CompUSA Direct	Mail Order	336-337
360	COMPUTER DISCOUNT WAREHOUSE	Resellers	326-327
109	COMPUTER DISCOUNT WAREHOUSE	Resellers	328-329
101	Creative Computers	Hardware Software, Peripherals	312-313
075	First Source International	Notebooks, Memory, Peripherals	290
014	First Source International	Peripherals Software, Notebooks	291
272	First Source International	Memory Software, Notebooks	292-293
219	Insight Direct	Mail Order	324-325
027	Insight Direct	Mail Order	368
019	L.A. Trade	Memory	302-303
083	Magetron	Magetron Desktop System	309
018	MegaHaus	Drives/Storage	335
855	Micro Solutions Computer Products	Tape Backup, CDROM, Disk Drives	305
391/138	MicroMail Direct	Memory PCMCIA, Fax/Modem, LAN	297
010	Midwest Computer Works	Mail Order	306-307
398	Midwest Micro	Notebooks, Desktops, Peripherals	331-334
177	MPC Technology Inc.	Multimedia Notebooks	301
	PC Connection	Mail Order	320-321
092	PCs Complete	Mail Order	314-315
268	PCs Complete	Mail Order	316-317
053	PerComp Microsystems, Inc.	Mail Order	298-299
056	Pro Direct	Mail Order	287
043	SPSS Inc.	Statistical/Windows Software	330
081	Sunshine Computers	Notebooks/Laptops	294
210	USA Flex	Notebooks/PCs/Peripherals	318-319

PCMCIA

075	First Source International	Notebooks, Memory, Peripherals	290
179	Fujitsu Computer Products	PC Card	68
136	Hayes Microcomputer Products	Optima PCMCIA	171
321	Megahertz Corp.	X-Jack PCMCIA V.34 Modem	5
391/138	MicroMail Direct	Fax/Modem, Flash, SRAM, Drives	297
367	Motorola	Motorola Modems	391
920	US Robotics Inc.	Courier	36

PERIPHERAL SHARING DEVICE

150	SmartPrint/Dresselhaus	Smart Print	181
-----	------------------------	-------------	-----

PERIPHERALS

363	COMPUTER DISCOUNT WAREHOUSE	Peripherals	326-327
109	COMPUTER DISCOUNT WAREHOUSE	Peripherals	328-329
101	Creative Computers	Peripherals	312-313
176	Diamond Multimedia Systems	Stealth 64	96
	Epson America	Personal Document Station	10-11
075	First Source International	Notebooks, Memory, Peripherals	290
014	First Source International	Peripherals Software, Notebooks	291
	Gateway 2000	Peripherals	207-210
	Gateway 2000	Peripherals	48A-49
136	Hayes Microcomputer Products	Optima PCMCIA	171
219	Insight Direct	Mail Order	324-325
027	Insight Direct	Mail Order	368
015	Magetron	Magetron Monitors	20-21
398	Midwest Micro	Peripherals	331-334
367	Motorola	Motorola Modems	391
	Sharp Electronics Corp.	LCD Projection Panels	237
	Touche	Touche Touch Pad	90

POWER PROTECTION

162	American Power Conversion	Surge Protector	377
080	PC Power & Cooling	PowerProtection/Cooling Devices	94

PRESENTATION SOFTWARE

	Microsoft	Microsoft Office	C2-1
--	-----------	------------------	------

PRINTER ACCESSORIES

150	SmartPrint/Dresselhaus	Smart Print	181
210	USA Flex	Peripherals	318-319

PRINTERS

	Canon Computer Systems	Canon Scanners	84-85
014	First Source International	Peripherals Software, Notebooks	291
	Odutata	On 810s	82
081	Sunshine Computers	Notebooks/Laptops	294
001	Tektronix Inc.	Tektronix Printers	74
210	USA Flex	Printers	318-319

PROGRAM DEVELOPERS

348	Computer Associates	Openings	2-3
	Microsoft	Microsoft Visual Fox Pro	NE62-NE63
	Microsoft	Microsoft Visual Fox Pro	NE65

PROGRAMMERS TOOLS UTILITIES

348	Computer Associates	Openings	2-3
	Microsoft	Microsoft Visual Fox Pro	NE62-NE63
	Microsoft	Microsoft Visual Fox Pro	NE65
345	Powersoft Corporation	Information Management Software	249

PROJECT MANAGEMENT

348	Computer Associates	Openings	2-3
148	Primavera Systems	SureTrak	45

REMOTE COMPUTING

875	Emulex Network Systems	ConnectPlus LT	NE18
920	Perle Systems	Perle 833-Remote Access Server	NE69
	STAC Electronics	ReachOut	215
186	Symantec Corporation	Windows 95 - Launch	109-111
171	Symantec Corporation	Win 95 - NU	113
174	Symantec Corporation	Win 95 - NAV	115
173	Symantec Corporation	Win 95 - Navigator	117
920	US Robotics Inc.	Courier	36
211	Xircom	Modems	179

Advertisers' Index PRODUCTS

Reader
Service
No.

Company

Product

Page

RENTALS/LEASING			
002	HARTFORD COMPUTER GROUP	Mail Order	299
RESELLERS			
003	Magibronic	Magibronic Desktop System	309
018	MegaHes	Drives/Storage	335
010	Midwest Computer Works	Reseller	306-307
081	Sunshine Computers	Notebooks/Laptops	294
SCANNERS			
•	Canon Computer Systems	Canon Scanners	84-85
•	Epson America	Personal Document Station	10-11
091	Microtek	Scanners	385
SERVERS			
075	Emulex Network Systems	ConnectPlus LT	NE10
•	Hewlett Packard	HP NetServers	142-143
024	Micron Computer, Inc.	Micron Servers	NE2-NE3
008	NEC Technologies	NEC Servers	NE18
028	Perle Systems	Perle 833-Remote Access Server	NE69
309	S A G /Storage Solutions	Pentiums	231
•	STAC Electronics	Quick Share	213
038	Zaos Int'l	Zaos AMBRA Server	88
SHAREWARE SOFTWARE			
•	AT&T	AT&T Globalyst PC	158-157
SOFTWARE			
378	7th Level	Battle Beast	382
047	Adobe Systems Inc.	PostScript	250
364	American Small Business Computers	Design CAD 2D	28
254	Artisoft Inc.	Power Suite	26-27
393	Berkeley Systems	Totally Twisted	393
144	CompUSA Direct	Mail Order	336-337
007	Connectix	RAM Doubler	243
322	Corel Corporation	CD Office Companion	41
037	Corel Corporation	Draw 8	155
314	Corel Corporation	Family of Products	238
042	Corel Corporation	Wild Board Games	277
358	Corel Corporation	Movie Guide	383
101	Creative Computers	Software	312-313
014	First Source International	Peripherals, Software, Notebooks	291
•	IBM Corporation	Data Management Capabilities	52-53
•	IBM Corporation	Networking	NE14-NE15
219	Insight Direct	Mail Order	324-325
027	Insight Direct	Mail Order	368
383	Janus Systems	Contact Manager	87
383	Janus Systems	Contact Manager	87
365	Managistics, Inc.	Statgraphics Plus	22
•	Microsoft	Microsoft Office	C2-1
•	Microsoft	Microsoft Windows 95	160-161
077	NetManage, Inc.	Chameleon 4.5	NE71
•	Novell, Inc.	Novell Netware 4.1 Upgrade	NE11
•	Oracle Corp.	Workgroup 2000	NE5
043	SPSS, Inc.	Statistical/Windows Software	330
•	STAC Electronics	ReachOut	213
106	Symantec Corporation	Windows 95 - Launch	108-111
171	Symantec Corporation	Win 95 - NU	113
174	Symantec Corporation	Win 95 - NAV	115
173	Symantec Corporation	Win 95 - Navigator	117
008	Viste	Viste Graphics Software	267
SPREADSHEET/TEMPLATES			
•	Microsoft	Microsoft Office	C2-1
STATISTICAL SOFTWARE			
365	Managistics, Inc.	Statgraphics Plus	22
043	SPSS, Inc.	Statistical Software	330
057	StatSoft	Statistical Software	55
TCP/IP			
877	NetManage, Inc.	Chameleon 4.5	NE71
053	Parsoft	Smartterm	NE56
TRACK BALLS			
•	Touche	Touche Touch Pad	90
TRAINING/SEMINARS/CONFERENCES			
265	Softbanks Expos	Seybold San Francisco, 1995	264
358	Softbanks Expos	NetWorld+Interop, Atlanta 1995	279
355	Softbanks Expos	NetWorld+Interop, Atlanta 1995	367
UTILITIES			
904	Quarterdeck Office Systems	QEMM	235
VIDEO GRAPHICS/BOARDS			
127	ATI Technologies Inc.	Mach 64-64 Accelerator	255
176	Diamond Multimedia Systems	Stallin 64	96
124	Matrox, Inc.	MGA Millennium	33
WINDOWS SOFTWARE			
047	Adobe Systems Inc.	PostScript	250
364	American Small Business Computers	Design CAD 2D	28
393	Berkeley Systems	Totally Twisted	393
•	Communication Intelligence	Handwriter for Windows	78
348	Computer Associates	OpenImage	2-3
007	Connectix	RAM Doubler	243
322	Corel Corporation	CD Office Companion	41
037	Corel Corporation	Draw 8	155
314	Corel Corporation	Family of Products	238
042	Corel Corporation	Wild Board Games	277
358	Corel Corporation	Movie Guide	383
101	Creative Computers	Software	312-313
396	Discovery Networks	Discovery Channel On-Line	372-373
365	Managistics, Inc.	Statgraphics Plus	22
•	Microsoft	Microsoft Office	C2-1
•	Microsoft	Microsoft Windows 95	160-161
077	NetManage, Inc.	Chameleon 4.5	NE71
148	Primavera Systems	SureTalk	45
043	SPSS, Inc.	Statistical Software	330
•	STAC Electronics	Quick Share	213
•	STAC Electronics	ReachOut	213
057	StatSoft	Statistical Software	55
008	Viste	Viste Graphics Software	267
WORD PROCESSING SOFTWARE AIDS			
•	Communication Intelligence	Handwriter for Windows	78
WORK GROUP SOFTWARE			
•	Lotus Development Corporation	Word Pro	72-73
•	Lotus Development Corporation	Lotus Notes	NE27-NE46
081	Novell, Inc.	GroupWise	NE49
WORKSTATIONS			
308	S A G /Storage Solutions	Pentiums	231

For Advertiser Categories see MARKETPLACE PRODUCT INDEX, page 339



Coming Up

Internet Access

On-line services like America Online, CompuServe, and Prodigy now offer access to the virtually unlimited resources of the Internet. But how easy do they make it? What parts of the Net do they let you access? How much does it cost? This feature focuses on the Internet access provided by on-line services and compares it with that of traditional Internet service providers.

Web Publishing

We scope out the latest on the World-Wide Web publishing front with a look at five Microsoft NT-based servers. And in case you're trying to decide which platform to run your Web server on, our platform shoot-out reviews four of the most popular systems. We also look at special-purpose Web publishing tools.

Internet Suites

Connecting to the Internet has never been easier. Choose integrated applications that offer a complete Internet experience or a suite of distinct Internet tools. Either way you'll want a Web browser, an e-mail client, a newsgroup reader, an FTP client, and more. We review 15 products in our search for the perfect Internet suite and preview some hot new products that are speeding toward release.

HTML Editors

Behind every Web home page, there's an HTML-formatted document. Tagging documents in HTML isn't hard, but it takes time and involves a learning curve. Not to worry: HTML editors abound. We review five that are available commercially, as well as freeware and shareware editors. We also look at the future of HTML—Version 3.0, Netscape extensions, and HotJava—and show you how we create the *PC Magazine* home page.

C++ Tools for Windows 95

Windows 95 brings new challenges for developers: a 32-bit API, a new SDK, new interface elements, and new types of system events. It also heralds changes to their favorite C++ tools. We survey the Windows 95 SDK and four C++ development packages from Borland, Microsoft, Symantec, and Watcom.

Accounting Software

Windows accounting software is finally here in force. We examine eight Windows-based LAN accounting packages and take an early look at other packages currently under development.

Editorial Product Index

Reader Service No.	Product	Company	Page
442	AcerPower	Acer America Corp.	192
443	ACW P5-120V	All Computer Warehouse	195
976	AirLan/Bridge Ultra	Soltek Corp.	NE66
440	Amazing 3-D Games Adventure Set	Coriolis Group Books	69
458	Apogee P133	GST/Micro City	214
461	Apollo 120	HiQ Computer Systems	217
461	Apollo 133	HiQ Computer Systems	217
421	ArcSoft PhotoStudio 1.5 for Windows	ArcSoft Inc.	61
967	AsanteFast 100 Hub	Asante Technologies Inc.	NE64
418	AT&T Globalyst 130	AT&T Global Information Solutions	61
970	ATM OC-3 STS-3c/STM-1 Network Processor Module	Cisco Systems Inc.	NE64
403	AudioTrix Pro	MediaTrix Peripherals Inc.	44
463	Austin Power Plus 120	IPC Technologies Inc.	219
463	Austin Power Plus 133	IPC Technologies Inc.	219
982	Batch Services for NT, Version 1.0	Intergraph Corp.	NE52
451	Benchmark P120	DFI	206
451	Benchmark P133	DFI	206
980	BitSurf	Motorola	NE48
453	Blue Thunder Triton PT5P120B	DirectWave Inc.	211
453	Blue Thunder Triton PT5P133B	DirectWave Inc.	211
408	Boris 1.0	StarBase Corp.	56
487	Borland Paradox for Windows 5.0	Borland International	239
445	Bravo MS-T P133	AST Research Inc.	195
419	Canon BJC-610	Canon Computer Systems Inc.	61
973	CD Net v1.0 for Windows NT	Meridian Data Inc.	NE64
452	Celebris XL 5133	Digital Equipment Corp.	206
405	Conversions Plus, Version 3.0	DataViz Inc.	47
959	CreditCard Ethernet+Modem 28.8	Xircom Inc.	NE59
412	Delrina WinFax Scanner	Delrina Corp.	42
411	DeltaGraph Pro 3.5	DeltaPoint	42
430	Design Shop for Windows	DataCal Corp.	66
447	Deskpro XL 5120 Model 1050/MX	Compaq Computer Corp.	200
450	Dimension XPS P120c	Dell Computer Corp.	205
450	Dimension XPS P133c	Dell Computer Corp.	205
952	DirectRoute Remote RO-1	Symplex Communications Corp.	NE17
486	Dream Media P5-120	Zenon Technology Inc.	236
486	Dream Media P5-133	Zenon Technology Inc.	236
546	ELSAmotion	ELSA Inc.	48
977	EtherExpress PRO/100 Smart adapter	Intel Corp.	NE26
970	Ethernet Network Processor Module	Cisco Systems Inc.	NE64
951	Everyware 2060-RO	Combinet Inc.	NE12
467	Executive Pentium-PC	Mitsuba Corp.	223
469	Expert System Plus 120	National MicroComputers	225
469	Expert System Plus 133	National MicroComputers	225
431	FileABC, Release 5.0	FileABC, A Nevada Limited Partnership	61
474	5 LX-TR/1Z-120	Reason Technology Inc.	228
474	5 LX-TR/IE-133	Reason Technology Inc.	228
483	Flex PT-133 Multimedia System	USA Flex	234
975	Glass-hopper	LANHopper Systems Inc.	NE66
446	Globalyst 380	AT&T Global Information Solutions	200
446	Globalyst 730	AT&T Global Information Solutions	200
410	HotelDisk, Version 1.0	Official Airline Guides	56
439	HP DeskJet 1600C	Hewlett-Packard Co.	37
955	HSM for NetWare 1.0	Cheyenne Software Inc.	NE22
415	Hurricane	Helix Software Co.	50
449	HyperSpeed MPEG Multimedia 4x	Comtrade	204
981	IBM 7845 Network Terminator	IBM Corp.	NE54
444	InfoGold P120M	American MultiSystems	195
444	InfoGold P133M	American MultiSystems	195
960	Instant Internet 2.0 for NetWare	Performance Technology Inc.	NE60
423	Internet In A Box 2.0	CompuServe Internet Division	66
426	Lombard Internet Securities Trading Web site	Lombard Institutional Brokerage	66
464	Magna Graphics ProMedia Pentium 120	Maximus Computers	220
416	MagnaRAM for Windows	Landmark Research International Corp.	51
475	Media Master	Royal Computer Inc.	228
479	MediaStar 5120	Tangent Computer Inc.	230
479	MediaStar 5133	Tangent Computer Inc.	230
962	MegaSwitch 100 switches	NBase Communications	NE59
488	Microsoft Access 2.0	Microsoft Corp.	239
436	Microsoft SQL Server 6.0	Microsoft Corp.	37
424	Microtek PageWiz	Microtek Labs	62
971	MVP144IV2 (internal)	Cardinal Technologies Inc.	NE65
971	MVP144XV2 (external)	Cardinal Technologies Inc.	NE65
971	MVP288IV (external)	Cardinal Technologies Inc.	NE65
971	MVP288XV (external)	Cardinal Technologies Inc.	NE65
417	NEC Versa 2000D	NEC Technologies Inc.	61
953	NetBlazer LS ISDN	Telebit Corp.	NE19
409	Netscape Navigator Personal Edition	Netscape Communications Corp.	56
441	Net Sports	Michael Wolff & Co. Inc. and Random House	69
961	NetTools 5.3	McAfee	NE59
983	NetWare Client for Windows NT	Novell Inc.	NE57
470	N5120P PowerStation	NETIS Technology Inc.	226
964	Norton Desktop Administrator 1.0	Symantec Corp.	NE60
966	100VG-Hub 15	Hewlett-Packard Co.	NE59
481	133/55 Workstation	Tri-Star Computer	232
429	Page Magic 2.0	NEBS Inc.	66
963	PCnet-Mobile	Advanced Micro Devices Inc.	NE60
406	PCTeX for Windows, Version 2.0	Personal TeX Inc.	47
477	Performance P133T	Sys Technology Inc.	230
457	P5-120 Best Buy	Gateway 2000 Inc.	214
466	P5-133 Office PC	MidWest Micro	222
460	P5-133 Tower	Hewlett Rand Corp.	217
457	P5-133 XL	Gateway 2000 Inc.	214
954	Pipeline 50	Ascend Communications Inc.	NE10
472	Poly 120T3	Polywell Computers Inc.	226
472	Poly 133T3	Polywell Computers Inc.	226
465	P133 Millenia	Micron Electronics Inc.	221
471	P120 Professional	Percomp Microsystems Inc.	226
471	P133 Professional	Percomp Microsystems Inc.	226
484	Power Station P-133	Vektron International Inc.	234
448	Premio Triton P133	CompuTrend Systems Inc.	201
428	Professional Interactive Chinese for Windows, Version 2.0	VentureTech Inc.	62
462	Professional-133	Hymco Technologies Inc.	218
468	Pro Media 120	Multwave Technology	224
481	Pro-17 Workstation 120	Tri-Star Computer	232
473	QP5/120 SM-1	Quantex Microsystems Inc.	226
401	Quicken Financial Planner	Quicken Investment Services Inc.	54
454	QUIN-54M/P120	DTK Computer Inc.	212
454	QUIN-54M/P133	DTK Computer Inc.	212
438	Remove-IT Version 2	Vertisoft Systems Inc.	46
965	SafeStor/FT	Cubix Corp.	NE60
985	SCO Open Server Release 5	The Santa Cruz Operation Inc.	NE47
974	Series 5000 Frame Relay Optimizer	Telco Systems Inc.	NE64
456	Step Pro 133	Everex Systems Inc.	212
476	STF 120	SAG Electronics	228
476	STF 133	SAG Electronics	228
956	Storage Manager 4.0	Palindrome Corp.	NE21
427	StreetSmart 2.0 for Windows	Charles Schwab & Co. Inc.	66
480	TCS-5210	Tatung Company of America Inc.	232
966	10/100VG Selectable PCI LAN Adapter	Hewlett-Packard Co.	NE59
972	33.6-Kbps modems	Supra Corp.	NE65
437	3D Fax Professional	Infomaging Technologies Inc.	46
478	Thunderbolt P-120E	Tagram System Corp.	230
478	Thunderbolt P-133E	Tagram System Corp.	230
455	ThunderBrick 120	Ergo Computing Inc.	212
455	ThunderBrick 133	Ergo Computing Inc.	212
420	TransferPro for Windows	Digital Instrumentation Technology Inc.	62
414	trueSpace2	Caligari Corp.	40
407	TrueTeX for Windows, Version 4.0	Kinch Computer Co.	47
468	Ultra Power 133	Multwave Technology	224
482	UT-P120 Lightning	Unitek Technology Inc.	232
452	Venturis 5120	Digital Equipment Corp.	206
984	V Everything modem feature set	U.S. Robotics Inc.	NE65
459	Victoria P133	HD Systems Inc.	214
545	VisualAge C++ for OS/2 3.0	IBM Software Solutions	48
404	Vivid3D Speakers	NuReality	44
979	WaveSwitch 100-8	PlainTree Systems Inc.	NE52
979	WaveSwitch 100 FL	PlainTree Systems Inc.	NE52
978	WhereAbouts, Version 1.0	Futurus Corp.	NE50
958	WinFrame for Networks	Citrix Systems Inc.	NE59
402	WinSales 3.0	WinSales Inc.	54
413	xRes 1.2	Fauve Software Inc.	40
422	ZAP-it	DTS Wireless	61
485	Z-Station GT	Zenith Data Systems	234

NE—Network Edition.

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Abort, Retry, Fail?

THE LIGHTER SIDE OF PERSONAL COMPUTING

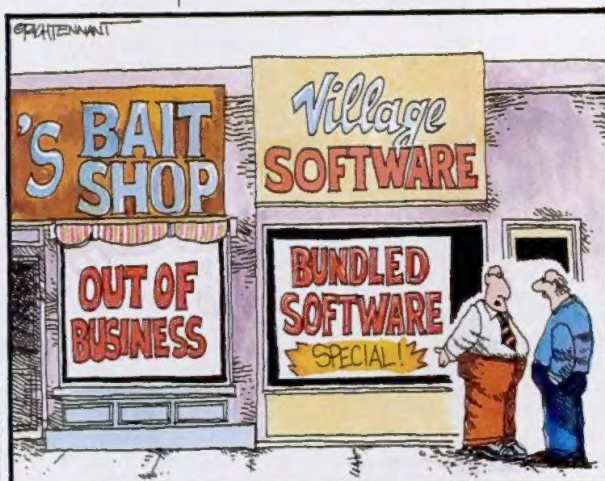
By Don Willmott

Ten Anagrams for "Information Superhighway"

1. New utopia? Horrifying sham.
2. Hi-ho! Yow! I'm surfing ARPANET!
3. Oh-oh, wiring snafu: empty air.
4. Oh, wormy infuriating phase.
5. Inspire humanity, who go far.
6. Waiting for any promise, huh?
7. When forming, utopia's hairy.
8. Hey, ignoramus—win profit? Ha!
9. A rough whimper of insanity.
10. Enormous hairy pig with fan.



 ARF on the road: Alexandria, Virginia. Make way for the ISA bus.



Richard Tennant

"THE AMI PRO AND WORMS AIN'T SELLING SO GOOD, BUT THE QUATRO PRO AND GRUBS ARE MOVIN' LIKE HOTCAKES."

Greetings from Translation Hell

Faithful reader Kim Baker found this statement on the side of a Maximus MediaNote CD Book shipping box: "Winning at the computer games means getting an intelligent partner in portable computing. This computer not only offers you with generic functions for mobile computing, but also more unique Features."

 Spotted on the side of an APS Technologies box.



Greetings from Public-Relations Hell

Here's how a recent Conner Peripherals press release explained some product delays: "The production delays resulted from a combination of technical launch issues and component shortages during critical ramp phases, including a major decommitment of headstocks for some of the most popular new products."

Acronym Analyst:

Our TLA list approaches 17,576! We seek an expert with SQL and C++ on IBM, DEC and SGI CPU's. Needs experience with GNU products, AWK, and SED for AIX and BSD. BTW - work with NFS, NIS, DNS, and TCP is AOK. Should have hands-on experience configuring write-only memory chips.

Telephony Systems Developer:

 Here's the ultimate nerd job. (*The Denver Post*)

If your entry is used, we'll send you \$50 and a PC Magazine T-shirt. Send your entries to Abort, Retry, Fail?, PC Magazine, One Park Ave., New York, NY 10016-5802. Winners this issue: Kim Baker, Matthew Bell, Greg Fulton, Eric Marlow, Roy McKinney, and Brian Wilson.

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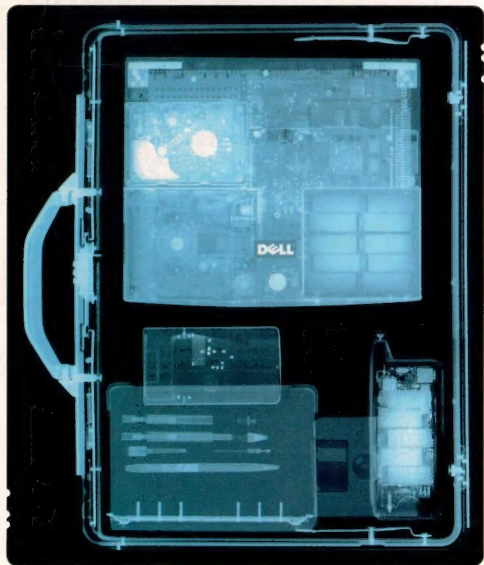
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Dell's featured digital artist is Sanjay Kothari of New York, NY.